SEVENTY-THIRD YEAR

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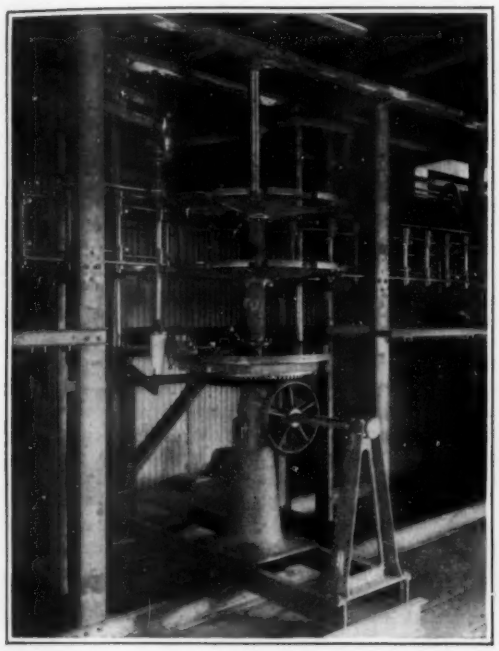


A single unit of the machine. The steel hand about to grasp a paper bottle and remove it from the core

Making Milk Bottles of Paper

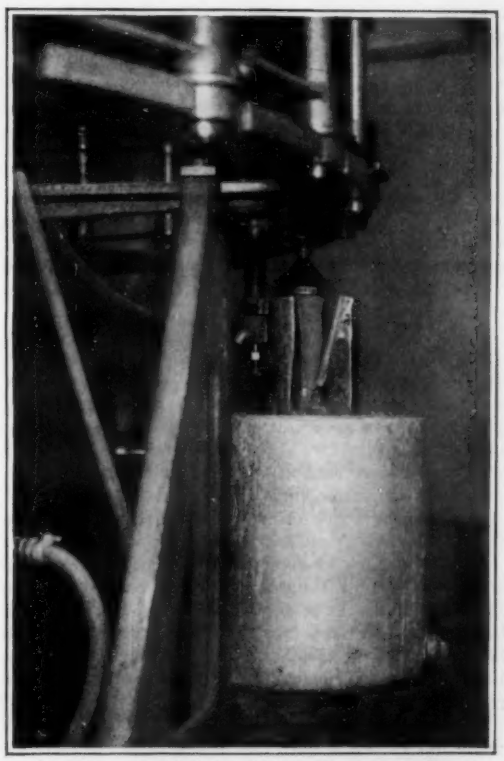
PREPARATIONS have about been completed to land a knockout blow upon another American institution in the interests of health and efficiency in the home. The campaign against the glass milk bottle has been fathered by doctors and health experts, who have united in condemning the old-fashioned milk bottle as a pernicious germ carrier. They are demanding that destructible bottles be used for the distribution of milk in the homes of dairy patrons, so that they cannot be returned to the dairy to be refilled and sent out another time, laden perhaps with germs picked up in the first home.

The first state to declare war on the glass bottle was Pennsylvania, Health Commissioner Samuel G. Dixon sounding the death knell of the glass bottle in a statement branding it as a menace to health. An order declaring that the glass bottle must go has since been issued by the Health Department Advisory Council. In some communities progressive dairymen have, by voluntary adoption of destructible bottles, anticipated such action as that taken in Pennsylvania. The most common type of the destructible bottle is made of light cardboard which has been coated with paraffin. It is air-tight and shuts out all light, the latter being a common enemy to pure or sweet milk. Milk can be kept in a fresh condition in these paper bottles many hours longer than in the glass bottles, an item which will commend the new bottle to housewives generally.

Recently in a western city health experts made a special survey of the city to determine the status of the milk bottle as a menace to health. These investigations resulted in the returning of numerous indictments against the glass bottle. In scores of homes they discovered that housewives used the empty bottles as receptacles for vinegar, kerosene, gasoline and other liquids before returning them to the dairies. Inasmuch as all of these bottles were returned and washed in the same vat it was impossible to eliminate all acid traces in the bottles, with the result that the milk spoiled more rapidly. In the interest of the baby health movement the committee urged the elimination of the glass milk bottle as a common disease carrier. Inasmuch as the new type of bottle cannot be returned to the dairy to be refilled, the housewife can make whatever use of the bottle she desires without endangering the health of others.

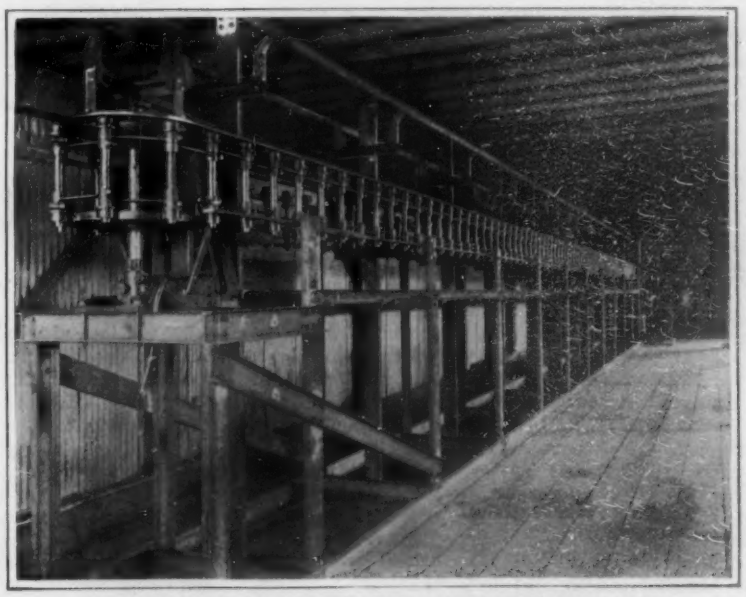
In connection with this rather general movement against the familiar friend of our back steps and dumbwaiters, it is of interest to note that a new machine has just been perfected by a western inventor which will manufacture paper milk bottles at the rate of five thousand an hour. This machine is 97 feet long and costs over $15,000. It is a radical departure from previous contrivances in that it manufactures the new bottles direct from wood pulp rather than from a finished paper, as is the case of practically all the containers on the market to-day. This feature enables it to turn out the completed product at a very low cost well within the reach of the average milk dealer. It is claimed that the new paper bottle is cheaper in the long run than the common glass bottle in use at the present time.

Only three men are required to operate the machine and from beginning to end the milk bottle is handled only by steel fingers, so that the apparatus meets all sanitary requirements. The pulp used is what is known as mechanical pulp, but the process does not require exclusively the high-priced paper pulp. In fact it is said that any fibrous wood will work as well as the customary spruce, which is fast becoming scarce on account of the tremendous amount of it consumed in this country for the manufacture of paper. Less than half an ounce of wood pulp is required to make one of the new sanitary bottles and one ton of pulp will produce 60,000 containers.



Pressing a bottle into shape as it emerges from the mass of raw pulp

The process of manufacture is simple. A steel core is dipped into a tank of raw pulp and, by means of four clamps, the pulp is pressed around the core and into a seamless body, much as a sculptor would press soft clay into shape with his hands. During this operation the bottle revolves three complete times, the clamps pressing at every one third turn. Thus the paper and the bottle are formed in one and the same operation. The bottle next passes through a powerful drier and over a stencil cut which prints on it the name of the milk dealer, the capacity of the bottle, etc. It is then removed from the core by a steel hand and deposited on a belt conveyor which delivers it to a machine that crimps on the bottom and top. The bottle is then given a paraffine bath that renders it impervious to liquid or acid and is automatically packed in dust-proof cartons for delivery to the dealer. The operation is continuous and it takes about eight minutes to convert the raw pulp into the completed bottle.



General view of the paper milk-bottle machine which turns out 216 bottles in 159 seconds

The Quest for Improved Methods of Measuring Leather Hides

A PROBLEM involved in the measurement of leather which is of very great importance to the tanners and the shoe manufacturers has been brought to the attention of the United States Bureau of Standards, and an improved method of measurement is to be suggested by the bureau.

An investigation was conducted in the State of Massachusetts for the purpose of obtaining data on the subject. All upper leather and, in fact, all leather except sole leather is sold on the basis of area measurement. The area of the skins is determined by passing them through measuring machines, of which but one general type is now widely used. The investigation showed beyond question that the methods hitherto in use in the testing of the machines had been inadequate. The machines gave widely divergent results when actual calfskins were passed through. Conditions have been very unsatisfactory because certain makes of machines, while giving correct indications on the usual tests applied by the State weights and measures officials, gave apparently a considerable excess measurement on actual hides when compared with other machines in use in the same region.

The cause of the difference was found to be largely the overspeeding of certain machines, which resulted in a serious error on account of the momentum or overrun of the measuring wheels beyond the point at which they should stop. A method will be submitted to the State Commissioner of Weights and Measures by which the proper limit of speed of feed may be fixed.

In order to settle a controversy between a tanner and a shoe manufacturer five typical calfskins were measured on five different machines, and separate sets of readings were taken for different speeds of operation, so that all the conditions of the problem might be as fully determined as the nature of the apparatus would permit. After comparison of these data with the actual area of the five calfskins as determined by careful planimeter measurements, a report will be made giving the characteristic errors and deviations of the five machines tested, and offering advice on the manner of *tests and maintenance* of the measuring machines.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Wanted—Congressional Appreciation of Scientific Research

LOCATED in the outskirts of the City of Washington there is a certain Federal Bureau which has been busily at work for years performing its duties quietly, but most efficiently. Whether it is because of its remoteness from the Capitol, or because of the academic sound of its name, we do not venture to say, but the fact is that the Bureau of Standards has received scant attention at the hands of Congress. We are inclined to believe that many Congressmen scarcely know of the existence of this bureau—certainly few of them have visited it—and it is but natural for them to think of it as a place where scientific instruments are calibrated and where the dimensions and masses of our measures and weights are checked up with minute precision.

From time to time the SCIENTIFIC AMERICAN has called attention to the valuable work done at this bureau. We have shown that it is actually one of our most important bureaus; for it is here that materials are tested and specifications drawn up to cover all the purchases of the Federal Government, ranging from cement for the locks of the Panama Canal to the character of the ink in a typewriter ribbon. Our manufacturers are waking up to the importance of having efficient testing laboratories, not only to test raw materials, but to examine products and make researches which will lead to new channels of development. It is just such a laboratory that is furnished by the Bureau of Standards for the work of our Government, and it is high time that our Legislature awoke to its value. The service of the bureau has been immeasurable in these recent years of industrial activity, not only for the Government, but for the public at large. In its work of testing the purchases of the Government, the Bureau of Standards has had to make investigations in all fields of technology, and its reports have been of immense benefit to our manufacturers. In a great many cases where special appropriations were provided, peculiar problems of manufacture have been studied, and important results have been attained. But while attention has been directed to the difficulties that have beset our industries, and to the wonderful achievements of our manufacturers in these strenuous days, the Bureau of Standards has received very little credit for the important part it has played in this work.

We have looked upon Germany as a wonderful example of the benefits resulting from industrial employment of scientific research. The great laboratories of Germany have done an incalculable amount of work for German manufacturers. In fact, industrial Germany has been built up on research work, and the whole public realizes the importance of giving the research laboratories everything they need. But although we have this ideal example before us, our Congressmen have evidently failed to appreciate the services of the bureau, for they have neglected to furnish this research laboratory with the means to procure the men, who are badly needed, to carry on the increased work of recent years.

The Department of Commerce should be able to do for our industries what the Department of Agriculture is doing for the farmer. Appropriations for the Department of Agriculture are made in a special budget, and there is never any lack of funds to carry out its work. The budget for the Bureau of Standards is included in a general miscellaneous appropriation bill, which Congressmen feel that they must keep down to the lowest limit possible. Time after time the bureau has called for additional funds, only to have its appropriation cut down in the Special Committee. We are sure that this state of affairs is due entirely to Congressional ignorance of the vital importance of the bureau.

Recently vast appropriations have been made for the extension of our navy. Is it realized that before a dollar of this money is spent the materials to be purchased will have to be carefully investigated by the Bureau of Standards? For it is only by such investigation that our Government can be saved from squandering large sums of money on faulty materials. Surely if we appreciate the value of intelligent buying, we cannot afford to stint the Bureau of Standards.

Small Ships an Answer to the Submarine

IT takes one torpedo to sink a 1,000-ton cargo boat and a single torpedo will send to the bottom a 50,000-ton ocean liner. Since no one submarine can occupy two places at the same time, it is evident that the amount of tonnage sunk by any one of the submarines will depend very largely on the size of the individual ships encountered. As between one 50,000-ton ship and fifty 1,000-ton ships, given a certain number of submarines in the waters through which these vessels pass, the total amount of tonnage sent to the bottom would, in all probability, be very much less were the total tonnage so scattered among multiple units, than it would be were it all contained in a single ship.

It is considerations such as these which have led to the proposal to build a large fleet of small wooden cargo boats, of from 1,000 to 1,500 tons capacity, equipped with internal combustion engines, for running the so-called German submarine blockade. This type of craft is well known on the Pacific Coast, where it has been built in considerable numbers during the past few years and has demonstrated its usefulness as a cheap and efficient cargo-carrier. These boats are equipped with Semi-Diesel motors and have a sea speed of about nine knots, this low speed being found sufficient for the demands of the coast trade in which they are engaged.

Judged from the commercial standpoint, the most effective size of these boats is between 3,000 and 4,000 tons; but for blockade running, it is proposed to build vessels of between 1,000 and 1,500 tons capacity and give them a speed of 14 knots, which could be secured in a 1,000-ton ship with the use of Full-Diesel engines of 1,500 horse-power.

Influential shipping men of this country are giving considerable thought to this proposal, and it has been suggested that a fleet of 1,000 such ships, equipped with bow and stern guns, would stand a very good chance of carrying their cargoes safely through the submarine zone; and this for several reasons. Their visibility would be low, as they would run to a length of from 175 to 200 feet, and using the oil engine there would be none of the tell-tale smoke, upon which the submarine relies for getting early sight of an approaching steamship. Their small size and quick turning ability, coupled with their armament of a couple of 3-inch guns, would render it difficult for the submarine to get within sufficiently close range to score a hit. If the enemy attempted to sink them by gunfire, their stout wooden hulls would give them more than an even chance against the frail and easy penetrable hull of the U-boat. Indeed, in view of the small value of such ships, it is doubtful if the U-boat commander would risk a duel upon the surface.

Obviously, for offensive purpose twenty 3-inch guns, carried on ten 1,000-ton ships, would be more effective than two guns in one 10,000-ton ship. Should we be involved in the war, moreover, a large fleet of these boats would be extremely useful for service as patrol boats, and for mine laying, net laying and other offensive and defensive operations.

If the scheme is put through, it would be possible to make use of the majority of the wooden shipbuilding yards on the Atlantic seaboard and on the Great Lakes, although the points where the greatest number could be rapidly built would be on the Pacific Coast, with its vast supply of lumber and its numerous and large lumber mills, and on the coast of Texas, where similar conditions are found.

To build a wooden ship does not require the yard and shop facilities which are necessary for the construction of steel boats. All that is needed is a crane for handling the heavier material, and a certain amount of wood-working machinery. To get the quickest results the boats should be absolutely standardized, and the timbers sent down from the mills cut to shape and ready, with a minimum amount of work, to be bolted into place. Constructed in such large numbers, and thoroughly standardized, it is estimated that these boats could be built for about $100 per ton, and at this rate, the 1,000,000 tons of wooden shipping could be set afloat within a few months at a total cost of $100,000,000; or for about the total cost of the whole European war for a single day. It is estimated that boats of fourteen knots speed could be built for $135 per ton, and after the war they would prove to be economical cargo-carriers in the inland trade and the coastwise service.

We have already suggested in these columns that in the event of war, this country could render very effective service by the construction of a large fleet of fast, heavily armed, sea-going submarine chasers, and if that effort were supplemented by the construction of a quickly built, large fleet of motor-driven wooden cargo boats, of the kind above described, we believe that the enormous service thus rendered by the United States, coupled with the vast operations of the Allies, would absolutely neutralize the present attempt of Germany to paralyze the world's commerce by ruthless submarine warfare.

The Good of Amateur Wireless

IT would be most unfortunate, indeed, if the Navy control of wireless stations in the United States were to become a *fait accompli;* for after all the wireless amateur is of known value to the country at large during time of peace, while his latent possibilities as a military asset in time of war are too prodigious to be overlooked. True, there have been occasions when certain amateurs have made veritable nuisances—even serious menaces—of themselves, but these have been few and far between, notwithstanding the fact that there are tens of thousands of private wireless installations among us.

The good the wireless amateur accomplishes is soon forgotten. Yet can we ever forget the monumental work of the boy wireless operators during the great floods which ravaged the Middle Western States during the earlier months of 1913? Many were the towns and communities which became completely isolated from the outside world, through the breakdown of telegraph and telephone systems; and yet, thanks to a handful of amateur wireless stations scattered throughout the inundated territory, the unfortunate people were able to keep in constant touch with the entire country which nobly came to their assistance.

Instances, such as the one just cited, have been legion in the past. The wireless amateur has always proved ready and only too willing to bend his hobby to a utilitarian service when the opportunity presented itself. And often has the wireless amateur aided naval and commercial operators in receiving long distance messages, when the latter, with their highly developed apparatus, were unable to hear the signals which were picked up by the crude, home-made apparatus of the boy-operator.

Most commendable of all, perhaps, has been the formation of a relay league by the wireless amateurs, enabling the sending of messages from and to almost any part of the United States, through chains of stations. Recently the American Radio Relay League announced, through its president, Hiram Percy Maxim of Hartford, Conn., the opening of a practical transcontinental service through a chain of amateur stations operated by members of the league. This organization has a number of so-called trunk lines over which the relayed wireless messages are handled; and in the case of the transcontinental service the initial message was sent from a station at Valley Stream, Long Island, and passed through the cities of Lima, Ohio; Chicago, Ill.; Dallas, Tex.; San Diego and Los Angeles, Cal. Of the 4,000 members of the American Radio Relay League at least 1,000 are capable of handling wireless messages of any kind, and the services of this efficient body have been offered to the Government for defence purposes.

Now then, is an independent, indestructible means of communication between cities and rural communities, such as is offered by our network of amateur wireless stations, of value to us? Should it be destroyed through adverse legislation?

We have already pointed out the value of our amateur stations in time of disaster. Only actual war can bring to the surface their dormant military possibilities. But this much we already know: Great Britain, without an army of amateur wireless amateurs, found it necessary to train thousands of wireless operators at the beginning of the war, not only incurring considerable expense, but a considerable delay as well in securing the necessary operators for service. Again, should we be drawn in war who knows but that our usual means of communication—telegraphy and telephony—might be rendered useless by the enemy? In which case the amateur wireless stations would still save the day.

Largest Possible United States Battleship

THE Naval Appropriation Act of August 29th, 1916, asked for particulars as to the largest battleship which could be built for the United States. In its investigation of this problem the Department realized that the Panama Canal would have to be taken as the limiting factor, at least so far as the dimensions of the hull were concerned. Working under this restriction, the Department found that it was possible to build a ship 975 feet long, 108 feet broad, drawing 34 feet, and mounting as a main battery fifteen 18-inch guns in five 3-gun turrets. The secondary battery would consist of twenty-one 6-inch guns, and four tubes for launching the new 21-inch torpedo, could be installed. The main armor would be 16 inches in thickness, and the under-water protection, in the way of cellular divisions of the space between inner and outer shell of the ship, and the thorough subdivision of the interior by extensive bulkheading could be carried to a point not as yet attempted in any existing warship. The maximum speed would be 35 knots. The ship would be able to travel 12,000 miles at cruising speed. The displacement would be 80,000 tons and the cost $50,000,000.

Automobile

A Resilient Tire Filler.—It is now proposed to use rubber sponge molded to fit the inside of the tire casing, and in this manner produce a puncture-proof tire. The car still rides on air, but this air is confined in innumerable little sacks.

A Point in Road Building.—In some places wire net reinforcement is being used to hold together concrete road surface that is laid over a poor macadam foundation. This seems a preposterous proposition, as it is generally conceded by engineers that the essence of a first-class road is a good foundation, and a makeshift like the above plan looks like a fraud on the taxpayer. This is no reflection on concrete, but it is a handicap to reputation of any material to use it in such a way.

Preventing Blow-outs.—A recent invention states that a large percentage of tire blow-outs are caused by air in the tire becoming heated, which results in greatly increasing the air pressure. To overcome this it is proposed to provide an air reservoir in or on the wheel, with connections between the reservoir and the air in the tire. It is expected that the action of the tire, when the car is running, will circulate the air in the tire around through the reservoir, which will act as a radiator, and thus keep the air cool and prevent its undue expansion. It is also expected that this air reservoir, by increasing the volume of air, will act as a shock absorber.

British Critics of American Profits.—For the last two years many British papers have been in the habit of alluding to American manufacturers, and especially our automobile builders, as "bloodsuckers," being incited thereto by the fact that our people were getting the profit on machines which they could not supply themselves. Lately the financial reports of many of these British manufacturers have been published, showing the results of their operations under war conditions, and mostly for their government; and from these it appears that, although their accounts with the government have not been definitely settled, the majority of the companies have felt perfectly safe to declare very handsome dividends, after deducting substantial funds for depreciation and reserves and also paying on behalf of their stockholders the heavy government tax on dividends. On a comparison of facts our manufacturers would seem to have the better of the argument in connection with the morals and principles involved.

Graphite in Bearings.—The question of using graphite in bearings comes up periodically, but the usual verdict of the public is unfavorable, solely because the majority of people get the idea that it is a substitute for oil, and attempt to use it accordingly. The mistake usually made is to overdo a good thing by putting in excessive quantities of graphite, with the result that it collects in wads in the bearing and tends to bind it, and also plugs the oil passages. Essentially graphite is not a lubricant, but an aid to keeping a bearing in good working order by filling up the minute irregularities of the shaft and bearing, and producing a beautiful, polished surface, and in this way reduces friction. To get this result only a very small quantity of graphite is necessary; and if too much is applied it simply collects in wads and defeats the purpose intended. It follows that the proper way to use graphite successfully is to thoroughly mix a small quantity with the lubricating oil at suitable intervals, and not to apply it continuously, for when the above mentioned polished surface is formed it will last quite a long time before requiring renewal.

Playing with the Carbureter.—When the engine shows signs of irregular working the carbureter is usually the first thing blamed, but in reality it is the last thing at fault. There is a fascination about its mysteries that urges on the average driver to experiment with it, without having any definite conception of its principles of operation, or the details of its too often intricate structural details, and consequently he is continually making what he calls adjustments, that are expensive in increased consumption of gasoline and decreased efficiency of the motor. Of course there are occasionally real troubles in the carburetor, but these are mostly the result of foreign matter that get in from not straining the fuel as it goes into the tank; and the indications of such troubles should be learned by every driver so they will be readily recognized and lead to a correct remedy, without disorganizing the entire apparatus in a blind search for the failure. Before the maker delivers a car, for his own reputation, he gets the best adjustment of the carbureter possible, and the less it is altered thereafter the better. Another point is the manipulation on starting. It is the common custom, when the engine has been standing, to first flood the carburetor; but in many cases this does not appear to facilitate matters. The trouble is that the manifold already contains a quantity of condensed gasoline, left over from the previous run, very frequently an ample sufficiency to start the engine; and if the carbureter is flooded in addition the mixture is made too rich to explode. It is good policy to study the carbureter, but to avoid interfering with it.

Science

Testing of Clinical Thermometers.—According to a new and revised edition of the Bureau of Standards circular on this subject, more than a million clinical thermometers are manufactured every year, and thousands of them are unreliable. In view of the important part they play in modern medical practice, that is a serious matter. The Bureau of Standards certificate is an indisputable proof of reliability, and ought to be more generally demanded. Changes have recently been made in the methods of testing. The certificates heretofore issued contained tables of corrections at four points on the scale—viz., 96, 100, 104 and 108 degrees F. The new certificates will be issued only for thermometers correct within 0.1. degrees F. at "normal" (98.6 degrees), and within 0.2 degrees at 104 degrees, and will contain the statement that the thermometer is correct within these tolerances.

Geologic Names.—The U. S. Geological Survey sets an example which other scientific institutions in and out of the Government service might follow to advantage in exercising careful supervision over the technical nomenclature used by its members. The survey has a standing "committee on geologic names," of which Mr. T. W. Stanton is chairman. The chiefs of section in the Division of Geology and the chief of the Division of Alaskan Mineral Resources attend meetings of the committee when questions relating to their respective branches of the office are under discussion. Authors of manuscripts under discussion are also expected to be present at these meetings or to select someone to present their views. During last year 153 manuscripts, comprising 15,200 pages and involving about three thousand one hundred and fifty geologic names were passed on by the committee. The survey is compiling a stratigraphic lexicon of geologic formations.

Color Feeding of Canaries.—A Farmers' Bulletin of the Department of Agriculture on the care and feeding of canaries deals at some length with the methods of feeding during the molt by which the color of these birds may be deepened or intensified. Although the facts are well known to fanciers, the public at large—*i. e.*, the portion of it that keeps canaries as pets—will be interested in the detailed information set forth in the bulletin. Turmeric, marigold flowers, saffron, cochineal, annatto, port wine, mustard seed and other agents, rich in natural color are often used for this purpose, but it is doubtful whether they exert any real influence. So far as known, all successful color foods have red pepper as the base. This substance supplies an enriched color element to the blood, and it is the actual red of the pepper and not the spicy element that produces the result. The whole process of feeding is described in "Farmers' Bulletin 770."

Improvements in Gyro Compasses.—The Navy continues to increase the number of gyro compasses in use on its ships and to improve the older instruments of this character already in use. Single sets on some of the battleships have been made duplex. A gyro-compass test plant has been set up at the submarine base, New London, and at the Mare Island Navy Yard, while similar plants are proposed for Puget Sound and possibly Pearl Harbor. Several new attachments to the gyro compass for ship control aid have recently been added or are being experimented with. These include bearing indicators for the conning tower, bearing indicators for submarines connected with the periscope, large-angle roll brackets for submarines, course and distance recorder, and portable isolated battle repeaters for battleships. The Navy Department makes a practice of sending to navy yards, during each docking period of the fleet, a representative of the manufacturer or one of the fleet "gyro gunners" for the close inspection and overhaul of these compasses.

Malaria in the United States.—In a paper read before the American Public Health Association, Dr. John W. Trask calls attention to the tendency in this country to underrate the seriousness of malaria as compared with other less common diseases. Malaria is not usually a direct cause of death, but, on account of its effect in weakening the constitution, it is a potent factor in determining the average duration of life in areas where it is endemic. Accurate information concerning the prevalence of this disease is very difficult to obtain. Health departments pay little attention to it, and even practicing physicians have rather vague ideas as to its prevalence in their own communities. It is known, however, to be much less widely prevalent in the United States now than formerly. Fifty years ago the endemic area extended to the Great Lakes and into Canada. The northern boundary has gradually receded, leaving here and there more or less localized endemic foci. It has all but disappeared from Wisconsin and Michigan, states once badly infected, but still persists in certain sections of New England. It is also diminishing in many parts of the south. Probably no state in the Union is entirely free from it, and it undoubtedly constitutes a health problem and an economic problem of the first importance.

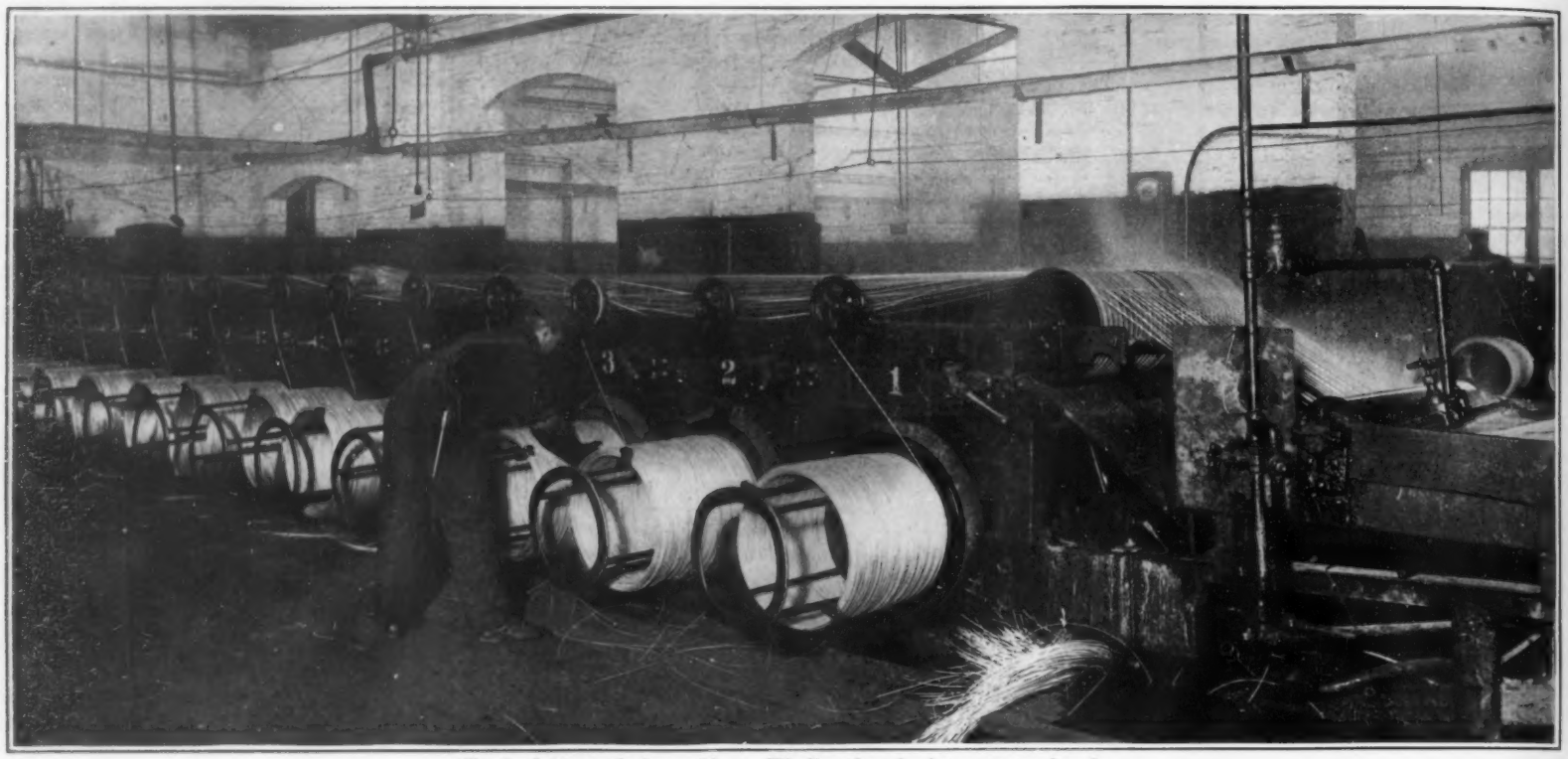
Aeronautical

The Light of a Match.—In a Midland town, states *Flight*, our British contemporary, a number of persons were fined for striking matches in the streets on the night of an air raid. The offence may appear to be a trivial one on the face of it, but it is really not so. In a recent series of visibility tests with certain kinds of light it was noted that on a dark night the light of an ordinary match was easily visible at a distance of a mile. Hostile aircraft do not, as a rule, fly at as low an altitude as a mile, and on the basis of the test just noted the striking of a single match would be without import. But, according to the evidence of a police superintendent, although the street lamps were all extinguished during the raid, there was almost as much light as though they had been lit, owing to people striking matches to light pipes and cigarettes.

The Passing Away of Count Ferdinand von Zeppelin on March 8th, at Charlottenburg, near Berlin, came as a surprise to the world at large. While the exact cause of his death was given as inflammation of the lungs on the one hand, and pneumonia on the other, it is held by many that the failure of his airships to terrorize England and bring the war to a speed end was a contributing factor in the death of the famous airman. Born in 1838 in Constance, Baden, Count Zeppelin spent the greater part of his life in the German army; and it is of particular interest to note that he was with the Union armies as military attaché in 1863, during our Civil War, at which time he made his first balloon ascent for the purpose of reconnoitering the Confederate lines. In 1892 he began his airship studies, having retired from military life. From then on the Count's biography is a series of bitter disappointments, tempered with a determination that has won the admiration of the entire world. Airship after airship which he constructed was destroyed; his fortune was wiped out; yet, aided by the German Emperor and financed by the German public, he at last succeeded in developing his airship to a comparatively high state of perfection. But the fact remains that the Zeppelins have never achieved in the present war the military triumphs that were expected of them by their inventor.

German Aviators Becoming More Daring.—Impartially speaking, the Entente aviators on the western front were beyond doubt in control of the air during the numerous battles on the Somme; but it appears to be equally evident that this marked superiority no longer exists. The German air service has greatly improved during the past three months or more. In this connection a special correspondent writing from British Headquarters, says: "Another effect of the sun to-day (November 9th) has been to bring out the German aeroplanes once more. During the bad days the British air reconnaissance never ceased, but the German aviators kept indoors. Perhaps it is owing to the vigorous "strafing' which the German air service received lately from their own headquarters staff that the airmen are showing a little more enterprise than they did. Gen. von Arnim told the German aviators in effect that the British were beating them hollow, and recommended greater effort and enterprise. Yesterday one of them flew over the British lines and (as the British aviators have been doing for months past) began to play with his machine gun upon the working parties below him. The working parties snatched up their rifles and gave the German so warm a time that he turned his nose upwards and scuttled out of range. This happened near Armentieres, and is the first instance of a German aviator coming close enough to the ground to work with his machine gun upon land parties."

Rotary and Radial Engines.—Before the war, states *The Aeroplane*, the best known designs of this composite group were the Gnome in its two types, the Rhone, latterly the Clerget, and—in England to some little extent—the Isaacson among the rotaries; and the Anzani and Salmson (Canton-Unne) among the radials. There were others, such as the Verdet, S. H. K., Dhenain, Esselbe, the Italian L. U. C. T., and several very promising two-stroke rotary propositions. But these were, at best, shop-tested rather than flight-proven. They had no commercial output to speak of; and it was no time to risk the series-faults that only a well-established and extensive production can discover and eliminate. So none of them appears to have survived the autumn of 1914. For possessing, as rotaries, any and every inherent defect or limitation that might be due to their type, they merely represented mechanical improvements—such as the substitution of piston valves or cuff-type valves for poppets—which, though promising well for strength and durability, contra-indicated physical difficulties in such essentials as lubrication. Others merely displayed variations of distribution mechanism of doubtful value. So there was no reason for their further adoption then. The first named half dozen have done so well ever since that there has been still less reason to substitute others of the same generic type that can hardly do better. And now that the power-demand has outrun that type, there is no visible reason to derive or further develop them.



The final stage of wire making. Winding the wire into measured reels

The Process of Spinning Threads of Steel

By Ernest Elva Weir

STEEL for wire-making is delivered to the wire mill in billets, bars four inches square, a yard long and weighing about one hundred and fifty pounds. The first operations are merely those of the rolling mill. The billets are brought to a white hot, pliable condition in a furnace and are then run through a series of grooved rolls in the rod mill. Rapidly switched from one set of rolls to another, each grooved finer than the one preceding, the billets are gradually reduced to a lead-pencil size in which they are known as rods. To offset the quicker cooling of the metal upon the decrease in size, the speed of the rolls is gradually increased until the rods are finally run through at the rate of 3,000 feet per minute. After being conveyed through a pipe to a device that coils them into bundles, the rods are carried on moving platforms to the open air and cooled. A bundle of rods represents one billet. From now on, the metal is brought to final shape while cold by the wire-drawing process, peculiar to this industry, and of which we illustrate certain stages.

The bundles are first immersed in a vat of dilute sulfuric acid, called a "pickling solution," to remove the black scale that forms during the rolling. Then, after most of the acid is got rid of in a hot water bath, the rods are put through what is termed the sulling process. This consists of running them very slowly under successive sprays of water which, in combination with the slight trace of acid and exposure to the atmosphere, forms a coat of slightly greenish cast. This so-called sull coat is absolutely necessary in the cold-drawing process. The rods are then dipped in milk of lime. This serves a three-fold purpose—to neutralize any remaining traces of acid, to protect from further atmospheric action, and to act as a lubricant during the subsequent passage through the steel die. Brittleness is next overcome by baking the lime-coated rods for several hours in an oven at a temperature of 400 degrees; after which they are ready to be drawn into wire.

A wire-drawing die is a solid piece of steel hot punched with a number of round tapered holes—that is, smaller on one side of the die than on the other. The die is clamped in a vise and the end of the rod forced through one of the holes. This projecting end is then fastened to a revolving drum that pulls the entire length of the rod through the die. It is now wire—round, smooth and without kinks. It is drawn through one die after another, each smaller than the one before, until reduced to the required size. With each draft through a smaller hole, the wire is not only reduced in diameter and increased in length, but is made harder as well, due to the steel being packed together more tightly as it passes through the die.

A pair of wire drawing dies

If the drawing process were continued long enough, the wire would become quite brittle. It is therefore necessary to stop drawing and run the bundles through an oven to anneal the wire and make it soft. This process enables the crystals to assume a more uniform and normal condition with respect to each other, thereby reducing to a minimum all local tension or strain from previous heating or working. This is the only way to make wire soft and ductile.

It takes careful watching to keep the dies in proper condition. When worn, the holes are closed up and carefully repunched to the proper size. For every fine and high duty wire, diamond dies are frequently used. In their construction, a small crystal of diamond is set into the opening of circular disc of metal; then a hole of the required diameter is worked through the diamond by means of special drills and diamond dust.

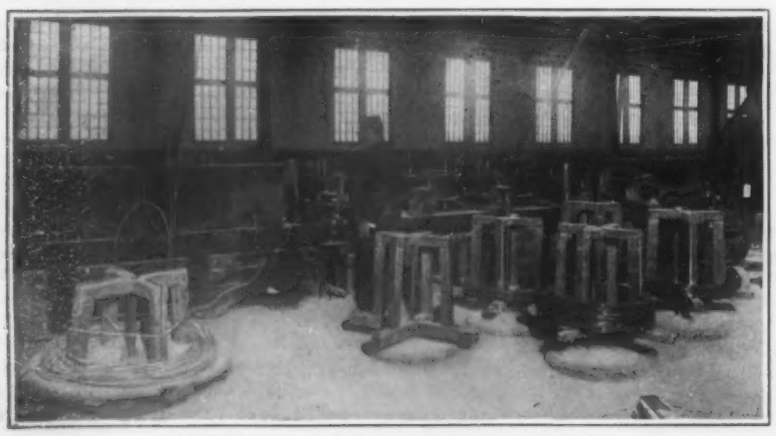
Annealing in connection with the galvanizing process is done either by running the wire through ducts in a furnace or through a bath of molten lead. In either case, a film of black scale is formed which is cleaned off by immersion in a vat of dilute sulphuric or muriatic acid. A fluxing treatment follows that removes the acid and prepares the surface of the wire for the molten zinc galvaniznig bath. The wire passes through this bath at such speed as to heat it to the temperature of the molten zinc before it comes out. Lastly, it runs through a shredded asbestos wiper which carries off the surplus zinc. It is then cooled and wound on reels.

High-Speed Steel Alloys and Other Rare Metals

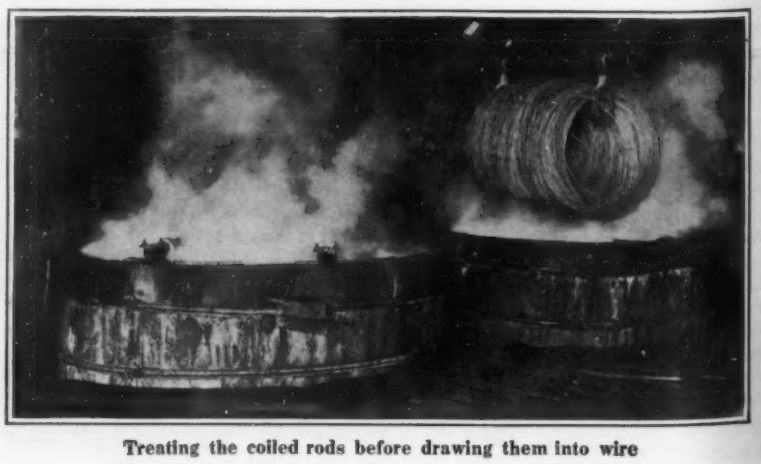
Where the United States Stands in the Production of these Important Elements

By L. W. Thavis

MANY of the minor or rarer metals, although showing only a small tonnage or money value when compared to the huge output of iron, copper, etc., have a greatly disportionate importance in their relations to the industries of the country, human comfort, or even



Drawing the wire down to gage through the die



Treating the coiled rods before drawing them into wire

the destruction of human life, and although none of them are indispensable, their lack would in some directions cause the wheels of progress to turn backward for a short space.

A very important group of the rarer metals, known as the steel-alloying metals, includes chromium, cobalt, nickel, tungsten, vanadium, and, of less importance, molybdenum and titanium. By the use of these metals wonderful alloy steels containing six or seven metals have been evolved, the "high-speed" steels, by the use of which one man now does as much work with metal-cutting machinery as could formerly be done by five men. These alloy steels have been largely though not wholly developed in the United States. The tremendous quantity of special steel ordered in this country by the warring nations has shown the extreme importance of the steel-alloying metals and prices have increased by leaps and bounds.

The alloy tool steels are now sold as high as $2 to $4 a pound as compared with 50 to 60 cents a pound formerly, and meet no competition from the fine carbon tool steels formerly used. For carbon steels with established reputations between 10 and 20 cents a pound was considered a good price.

For the "high-speed" tool steels, chromium and tungsten are essential; vanadium, cobalt, and molybdenum desirable. Tungsten and vanadium to supply present demands can be produced in this country easily; molybdenum, chromium, and cobalt for at least a portion of our needs are also available in our mineral deposits.

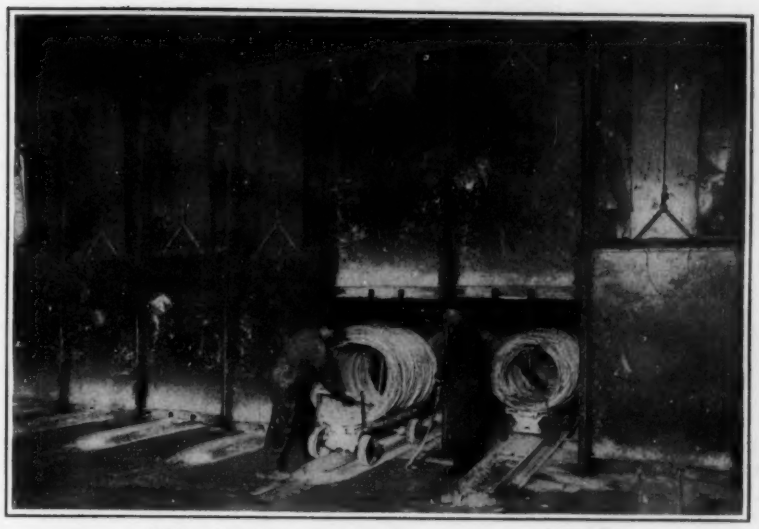
Alloy steels of simpler composition are used in many forms of machinery with great benefit. All shoes and dies in stamp mills and the tires of rolls used in crushing ores are made from steel containing chromium. Many of the best automobile axles and springs, locomotive frames and springs, and other machine parts that must stand hard usage and which must be reliable are made from steels carrying vanadium, or chromium and vanadium. For these uses it would be difficult to obtain sufficient chromium in this country, but there would be great difficulty in producing substitute steels.

Uranium is used in the manufacture of special steels and some of its salts are used for coloring glass, but the element is chiefly notable from its being the parent of that wonderful element, radium, which promises to be of very great importance in the treatment of disease. Through the coöperative efforts of the Federal Bureau of Mines and the National Radium Institute radium is now being manufactured on a commercial scale from the carnotite ores of Colorado at a cost one third the price asked by foreign producers of radium. This triumph of American invention and skill is not only making this country independent of foreign sources of supply, but is enabling American physicians to apply to the cure of cancer and similar diseases radium in quantities not available to physicians in Europe.

Nickel steels containing about 3.5 per cent nickle are extensively used in automobiles and other machines and in armor plate. The United States has no known large supplies of nickel ores, but substitutes can be provided.

Of titanium, also used in steels, the United States has in the rutile deposits of Virginia the largest available supplies of titanium dioxide known in the world. In addition to this there are millions of tons of titaniferous iron ores in the United States from which it will be possible to obtain titanium, especially for the manufacture of an alloyed steel.

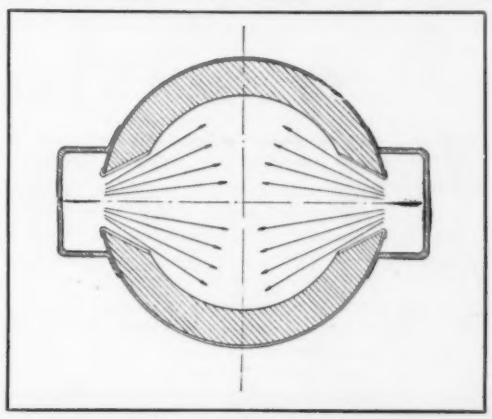
In addition to the millions of dollars in wages saved annually by the use of tungsten in steel, this metal is saving other millions of dollars to consumers of electric light. Incandescent lamps with tungsten filaments are now made which consume only about five-tenths of a watt per candle, against 3.5 watts per candle by the carbon filament lamp of ten years ago, so that now one may have for 15 cents as much electric light as he could ten years ago for $1, and of much better quality. The production of malleable tungsten has made possible such lamps, and the development of malleable tungsten from the practically infusible powder, in which



Baking the lime-coated rods to overcome brittleness

forms only tungsten was before known, was accomplished in this country. Tungsten is replacing platinum in intermittent electric contacts, and is in many places better than platinum; and this, with the use of nickel-chromium resistance wires, is probably responsible for a drop in the price of platinum.

The United States has sufficient supplies of tungsten for its use, though so long as cheaper ores can be obtained



Arrangement of tuyers in the body of the small cupola furnace

abroad they will be imported unless stopped by artificial means, such for instance as the imposition of an ample tariff.

The United States is also deficient in tin supplies, but substitutes, such as lead, zinc, and aluminum can probably replace it in practically all cases without great inconvenience. This country consumes more tin than any other country in the world and at the same time produces practically none. The output of tin in this country during 1915 was about a hundred short tons.

The increased demand for antimony of late, caused by the European war, has resulted in the opening of many deposits. The element is almost indispensable in type and bearing metals, and there has been a great demand for it from makers of shrapnel bullets. It has been mostly obtained from China and Mexico, but in this country sufficient supplies for our needs are obtainable, though at somewhere higher costs.

Of other of the rarer elements, arsenic, bismuth, selenium, etc., this country can develop supplies sufficient for any needs now apparent.

The Small Casting Furnace

WE illustrate upon our cover this week an interesting development in the iron founders technique, which makes possible the pouring of castings upon a much smaller scale than ever before. This baby cupola furnace was designed at Chicago for the use of technical schools; but its many practical features won it such instant recognition that its commercial exploitation in the interests of the small foundry soon followed.

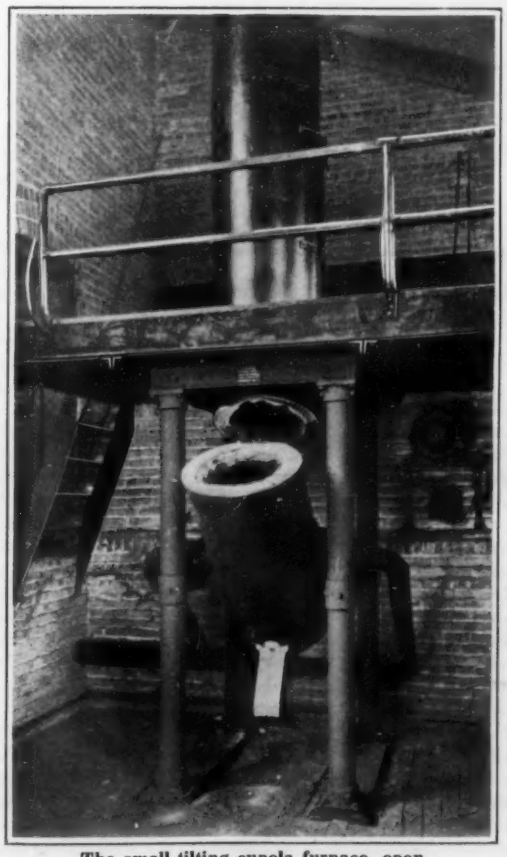
This furnace is built in two sizes, measuring 16 or 18 inches inside the lining, and having melting rates of 1,500 to 2,000 pounds per hour, respectively. The blast enters through the hollow trunnions, passes through the box-like castings on each side of the furnace, and then through the tuyeres into the furnace itself. The tuyeres flare inward, giving a uniformly soft blast around practically the entire circumference of the furnace. This does much to insure successful working.

There is an expansion joint provided below the platform to take up the expansion of the lower part of the furnace under heating. The four columns carry the weight of furnace and stack. The rectangular platform frame is of channel iron and supports the bed plate and charging door section and the stack. The whole construction is extremely rigid and substantial.

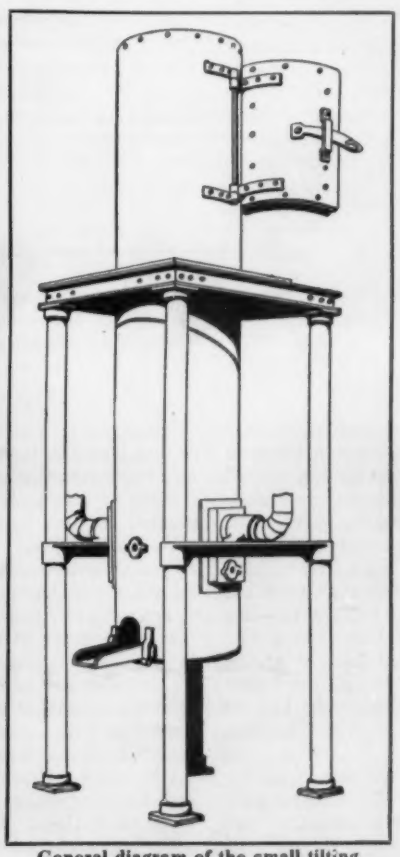
A feature is the tilting section shown open on our cover. This is not for the purpose of pouring, which is done by tapping in the conventional way, but rather for scraping, daubing and repairs. It is nicely balanced on the roller bearing trunnions and can be tilted with very little effort. When the furnace is closed in melting position, it is to all intents and purposes the same as the regular type of melting furnaces. But in the latter the inside diameter must be at least 24 inches, in order to make it possible for a man to enter and perform the operations named above; so the combination of tilting section and small bore is a particularly happy one.

The practical advantages of the small furnace for light and medium work are many. Its simplicity of operation is important; no expert is required to operate the furnace and keep it in repair. The entire process of preparing and running off a heat is one well within the range of the average founder's ability. Moreover, the work can be carried on much more expeditiously. In the case of a large furnace, but one man can go inside to work. About half a day is usually required to chip it out and daub it; and the fire has to be started several hours before iron is wanted. The small furnace can be made ready in a very brief time, and the iron begins to flow in equally short order.

Another item is that in the large furnace a small heat cannot be run off economically. Consequently every foundryman has experienced the annoyance of having a large proportion of the flasks and floor space in his shop tied up with small stuff waiting for enough molds to make a heat suitable for a large furnace. But in the small cupola a heat of 250 pounds is neither impractical nor extravagant of fuel. This ability to cast more frequently means that less floor space and fewer flasks are required, or looking at the matter from another angle, a shop of given size with given equipment can accommodate a larger number of men. This feature is of the greatest advantage where space is limited.



The small tilting cupola furnace, open for cleaning



General diagram of the small tilting furnace, ready for charging

Connecticut's Military Census

The Nutmeg State, at Least, Will Know Where It Stands If War Comes

"IT has been the official view of our government that the interest of the United States in this conflict is that of a neutral, although profoundly concerned, spectator; . . . but the swift march of recent events has compelled us to view gravely the imminence of our enforced participation. . . . In preparation for this contingency. . . . I recommend that power be given your Governor to take a census, classified with a view to their availability for the various activities of war, of the men of the state, together with an inventory of those physical resources of the state which war would call into requisition."

In these words, addressed on February 6th to a special joint session of his state's legislature, Governor Marcus H. Holcomb of Connecticut expressed sentiments which must be those of all thoughtful Americans. There may be wide divergence as to the degree of national humiliation which is preferable to war; but there can be no two opinions with regard to the war possibilities inherent in the present situation, and the vital necessity of meeting them with adequate preparedness. Realizing this, the General Assembly responded at once to the Governor's appeal, empowering him to proceed as he wished, to call upon all public officials for any aid whatever, and to draw upon the state treasury for all expenses incurred. The very same day a citizens' committee was in charge of the work, and grappling with the major problems of organization.

It was obvious that different methods would have to be used in the rural and urban sections of the state. In the former there was no danger of the returns being incomplete, once enumerators were found sufficiently interested to do their work well. This question was handled very judiciously by means of a letter which went out on February 7th to the first selectman of every town in the state, bearing the Governor's personal signature. After quoting in full the enabling act, this letter said, in part:

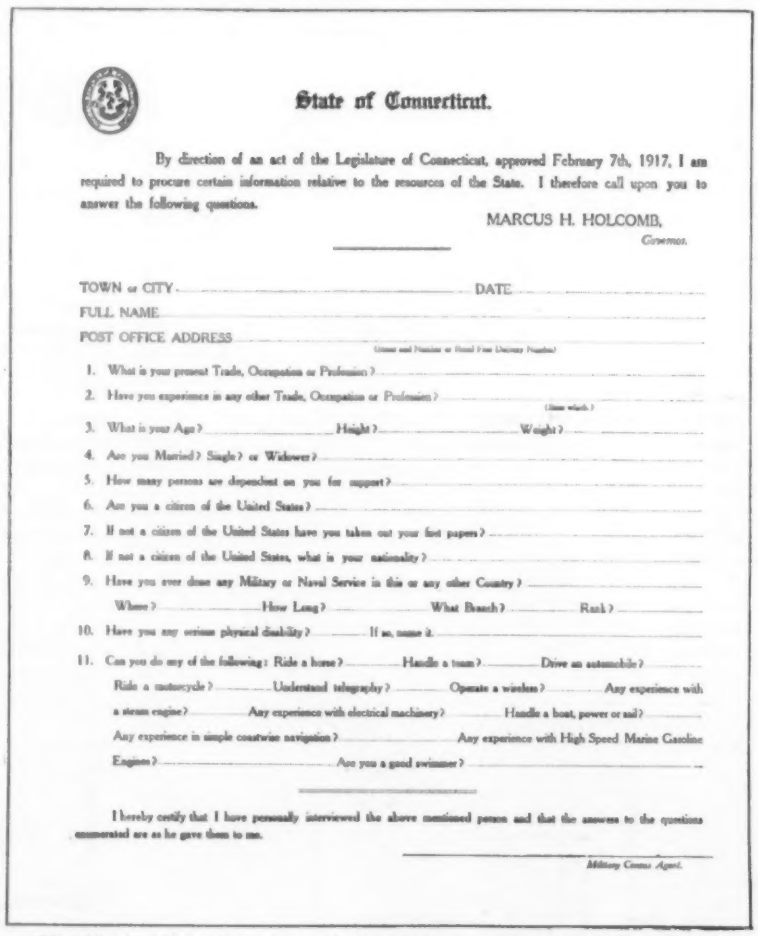
"The census is to be taken in each town, by agents who will bear a commission from me as Governor. I will appoint no man who will expect any reward other than the satisfaction of feeling that has done his best to serve his state in time of need. A list of questions to be asked every male resident above 18 years of age, the answers to which should at this crisis be in the possession of the state, has been prepared and submitted to government officials for approval or correction. Under the authority vested in me by the act above mentioned I call upon you to furnish the names of men in your town who will undertake, under you as selectman, the taking of this census. These agents should be selected by you so that each may cover a district of your town with which he is familiar and you should select them in such numbers that each may have approximately 50 residents to call upon."

This program went through with a hurrah. Imposing commissions, signed by the Governor and sealed with a huge gold seal, as well as neat little badges, were issued to the enumerators; and there was an enthusiastic rush to secure these coveted honors. A few districts, usually through misunderstanding of some sort, were backward; but in every case the Census Bureau was able to clear up the situation without hard feeling. One selectman reported that his town was populated by old hayseeds and young hyphens, neither of whom were in the least degree interested in anything like patriotism, and that there wasn't any sense in pushing the matter further. But when a Hartford lawyer invaded this town and, in tactful fashion, worked up a red hot mass meeting of practically every male resident, with the "hayseeds" driving ten miles to be there and the "hyphens" fighting for enrollment blanks, the selectman apologized for having misjudged his constituency. Then, too, there was the little town where the poll-tax enumerators had been in the habit of splitting their fee of six cents per name with those whom they enumerated, and where the residents laughed at the Military Census Takers who tried to tell them they were working for nothing, and consequently had no three-cent "divvy" to hand out. This tangle, also, was straightened out from Hartford.

In the cities there was never any problem of getting the leaders interested. Here the difficulty lay rather in assuring a complete census. How can one tell when all the male residents of New Haven have been canvassed? The Hartford plan, first to be worked out, and adopted by the other cities, furnished the best answer to this question.

The committee of 20 citizens decided that a preliminary list was a prime requisite. Voting and poll-tax lists were in existence, but were notoriously incomplete. However, they afforded a starting point. The names were transferred to a set of white cards arranged alphabetically, and to a set of buff cards arranged by street and number. This list was then checked up with the city directory and with the school lists. The committee felt that it has thus obtained the fullest possible check list of the males of Hartford of 16 years and over (the age limit finally selected to give the census more permanent value). Further names were of course added as the result of the canvass.

How to make the canvass was the next question. It was decided to canvass first all the large employment units of the city—insurance companies, banks, factories, department stores, public utilities, police and fire departments, etc. In every case coöperation with those in authority was assured. Thus, in a New Haven factory employing 17,000 men, every foreman had a commission and the census was taken complete in an hour. Of course by this method many non-residents were enumerated in the large cities; but the general principle followed has been to take a man wherever he is found, thus making certain that he will not have to be sought out later. The completed blank shows where his residence is; the chief of enumeration there is advised that he has been canvassed, and promptly checks him off his lists.



State of Connecticut.

By direction of an act of the Legislature of Connecticut, approved February 7th, 1917, I am required to procure certain information relative to the resources of the State. I therefore call upon you to answer the following questions.

MARCUS H. HOLCOMB,
Governor.

TOWN or CITY ..... DATE .....

FULL NAME .....

POST OFFICE ADDRESS .....
(Street and Number or Rural Free Delivery Number)

1. What is your present Trade, Occupation or Profession? .....
2. Have you experience in any other Trade, Occupation or Profession? ..... (State which.)
3. What is your Age? ..... Height? ..... Weight? .....
4. Are you Married? Single? or Widower? .....
5. How many persons are dependent on you for support? .....
6. Are you a citizen of the United States? .....
7. If not a citizen of the United States have you taken out your first papers? .....
8. If not a citizen of the United States, what is your nationality? .....
9. Have you ever done any Military or Naval Service in this or any other Country? .....
   Where? ..... How Long? ..... What Branch? ..... Rank? .....
10. Have you any serious physical disability? ..... If so, name it. .....
11. Can you do any of the following: Ride a horse? ..... Handle a team? ..... Drive an automobile? .....
    Ride a motorcycle? ..... Understand telegraphy? ..... Operate a wireless? ..... Any experience with a steam engine? ..... Any experience with electrical machinery? ..... Handle a boat, power or sail? .....
    Any experience in simple coastwise navigation? ..... Any experience with High Speed Marine Gasoline Engines? ..... Are you a good swimmer? .....

I hereby certify that I have personally interviewed the above mentioned person and that the answers to the questions enumerated are as he gave them to me.

Military Census Agent.

The blank which all male residents of Connecticut are asked to fill out

As the completed blanks began to come in, the corresponding cards were removed from the working files, so that gradually the original alphabetic file was weeded out, leaving only a residuum not covered by the unit system of canvassing. This residuum was further reduced by newspaper advertising and other publicity measures. Full use was made of churches, societies, clubs and orders of all kinds. But of course there remained a considerable bulk of names which had finally to be covered by house-to-house canvassing.

It had been the intention to hold the completed blanks in the office of the committee for each city till the census for that city had been finished; but of course this plan had to be abandoned to avoid congestion at headquarters. Accordingly the practice has been to ship to Hartford each night all the blanks gathered during the day.

Once upon a time the only way to post data upon a card for filing was to write upon the card. Nowadays we do not do this. The entire front of the card is covered with the numbers from 0 to 9, arranged in columns. The various items which we may want to post upon the card are represented by code numbers of one, two, three or more digits. Enough columns of figures are grouped under a single caption to accommodate the longest code number falling under that caption; and then all entries are made by punching out the appropriate code numbers in the proper columns.

As the completed blanks arrive from the cities and towns they are numbered consecutively. Each girl has her own numbering machine, locked so that when she reaches the even thousand she can go no further until the inspector has reset it. In this way a dozen girls may number blanks at once, without skipping numbers and without duplication.

The number blanks then go to code experts, who write down opposite each answer its code equivalent. The punching machines comes next. They work in pairs, one punching, one checking. The second operator goes through all the motions of punching each card, but if she strikes a key corresponding to a position which has not been punched on the card she is checking, her machine stops and rejects the card. Punching and checking thus proceed at incredible speed.

The completed cards pass to the sorting machines, which can be set to sort them into a dozen or less groups according to any desired combination of punch holes. In this way it is possible to weed out the records of all natural born citizens now engaged in clerical work, under a given age and over a given height and weight, and who can drive an auto and operate a telegraph key—or, of course, any other imaginable classification can be made.

As a matter of fact, the cards, before final filing, are merely sorted into a half dozen major age and disability groups. If the emergency arises, it will be a simple matter to run any of these groups through the machine at a rate of 7,200 cards per hour and isolate the cards which meet any desired specification. Names and addresses will then be located from the original blanks, which are filed away according to their consecutive numbers. The latter, of course, are punched in the first seven columns of the record cards.

The Governor's message and the Census Act were of date February 6th; the letter to the selectmen went out on the 7th; the mayors of the state were in conference at the Capitol on the 9th, and the Hartford plan, worked out in the meantime, was put before them. On March 2d over half the blanks for the entire state had been returned to the Census Bureau; by the middle of the month the work will have been finished, and the complete inventory of the state's man power will have passed into the personal custody of the Governor, where it will remain until occasion arises to use it.

Such an extraordinary record makes it plain that the census must have proceeded with the enthusiastic coöperation of all concerned. The performance of such a task by unpaid volunteer labor, an unheard of procedure, was largely responsible for this success, while the uniform use of the Governor's name in the first person was a factor of great value. It was clear that everybody was working for the Governor and for the honor of the thing, and that there was no axe-grinding in connection with any feature of the census.

Prominent citizens abandoned their business and gave 16 hours a day to the organization and supervision of the local enumeration and the central bureau. In two weeks 10,000 agents were commissioned. The great insurance companies of Hartford unanimously and without reserve put all their resources of machines and skilled operators at the disposal of the Bureau, and one of them gave it quarters. Girls from home and school, even married women, flocked to these quarters to volunteer for the many tasks demanding unskilled workers; and scores of girls went daily from a hard day's work to spend the evening in the Bureau's office. All this makes possible the broad statement that not one cent has been spent for labor; this has been a census of the people of the state, by the people and for the people.

In further emphasis of this point, if further emphasis be needed, may be cited the attitude of the public at large. A special effort was made to get before the people the facts that answering these questions in no sense constituted an enlistment; that the information was to be tabulated in code and pass into the personal care of the Governor; that each person might assume,

(Concluded on page 293)

The Remuneration of Industry by Research

Almost Limitless Possibilities of Discovery in Every Field of Industrial Endeavor

By Raymond F. Bacon, Ph.D., Director of Mellon Institute of Industrial Research, University of Pittsburgh

IN the late seventies, the Sutro Tunnel, at Virginia City, Nev., was quite famous as a piece of difficult engineering well executed. It serves to drain the mines of the Comstock Lode and was used as one outlet for the ore from those famous mines. Around the mouth of the Sutro Tunnel, covering an area of probably several square miles, is a very considerable tonnage of tailings, containing the gold and silver values which the metallurgical methods of the seventies could not profitably extract. I have recently seen at this point a large new cyanide mill, erected to handle this accumulation of tailings. However, this mill has never been operated, for subsequent to its completion it was found not suitable for the metallurgical treatment of these particular tailings. I refer to this case as illustrative of what has frequently occurred in American industry—the expenditure of large sums of money in plant erection and equipment without adequate information on the technology involved. Through Kansas and several other of the western states, in many of the small towns, there are large cement factories, most of which have never been productive or, at best, have been operated for only a short time. There are notable instances of such mismanaged development throughout the domain of industry—monuments to an old procedure of business in which the system of industrial research, as we understand it to-day, played no part.

In striking contrast are the numerous illustrations which may be cited to demonstrate that the modern conception of research—systematically planned and carefully executed preliminary investigation—has been a big factor in establishing successful manufacturing enterprises. We see a large electric company spending a sum running into the hundreds of thousands of dollars annually on one of the best equippped industrial research laboratories in this country and we find that some of the products of the researches of that laboratory, the various forms of tungsten lamps, have been conspicuous in extending the business of that company. This company in its advertisements has quite frankly acknowledged the importance of its research laboratories. In fact, on studying the matter, one is impressed by the truth that a large number of companies are beginning in a nation-wide way to advertise the fact that they are continually conducting well-directed research to improve their products. While the public at large does not understand the methods of research, enough of its significance has become popular knowledge for the recognition that the company which continually strives by research to obviate manufacturing difficulties or to improve and cheapen its manufactured articles is a progressive company and is apt to have the best quality of product that can be made by the aid of present-day science.

I am unfamiliar, in detail, with just what proportion of the business success of any one company could be directly ascribed to its research activities, but I do know that some fifty companies might be referred to which have found it profitable very materially to increase in the last five years their departments devoted to research. I recently had occasion to inquire of most of the American industrial concerns which conduct research regarding the growth of their laboratories. I was, of course, aware of the growing appreciation among our captains of industry of the value of research as applied to manufacturing, and consequently expected to find a considerable increase in the number of laboratory workers involved and in the amounts of money expended for this purpose. I was, nevertheless, astonished to find from the rules that increases of from 100 to 500 per cent in the research activities of these corporations were exceedingly frequent. There is only one conclusion to be drawn from all this, and this is that research *pays*—pays in a dollar-and-cents way.

I feel, however, that in this country we are only at the beginning of a real appreciation, and impressed estimation of what properly conducted research can do for industry. We are at the place, in our conceptions and understanding of research, that we were several years ago in regard to advertising, by which, of course, I refer to systematic publicity work. It was only a few years ago that many large concerns were in a very doubtful state of mind as to whether advertising actually paid and there were even cases of large commercial organizations that took pride in the fact that they did not advertise. But this attitude has gone the way that empiricism in manufacturing is rapidly following, and as a result advertising has become almost an exact science. Competent advertising experts are now able to present quite accurate estimates of precisely how many dollars worth of business each dollar spent in judicious advertising will return to a company; and on this basis our great organizations do not hesitate to lay out elaborate advertising campaigns covering a period of years and involving the expenditure of many hundreds of thousands of dollars. Publicity is now planned with a feeling of certainty that each dollar thus spent will bring in a certain number of dollars of future profits. I believe that, in exactly the same way, it would eventually richly reward American business houses with industrial and technical problems requiring investigation to devise systematic campaigns for the solution of their problems, such campaigns to involve intensive work by trained men over a period of years. I am firmly convinced that if research campaigns are carefully and properly laid out they are almost absolutely certain to return to the company many dollars of future profits for every dollar spent for research.

The possibilities of new discoveries in almost every field of industrial endeavor are almost limitless. Hundreds of men gifted with the genius for research could give their lives to investigation in the field of some industry and still that field would not be exhausted of research opportunities. In fact, research is in that regard different from certain ordinary lines of business; the greater the number of researches, the greater is the progress in a given field; but every new development in manufacturing creates new problems and the opportunities for discoveries become continually greater as we learn more and more of the possibilities of the materials with which we ordinarily deal in the manufactures and arts. In illustration, I shall cite some instances from the domain of iron and steel. We see tremendous advances made in imparting new properties to those old metals by means of mere traces of other metals. For example, it has been found that a mere trace of copper gives to steel the desirable property of resisting corrosion, while the addition in small amounts of vanadium or tungsten to steel affords a supersteel with certain physical properties far beyond those of any ordinary steel. We see the addition of magnesium giving to aluminum new properties of strength and casting quality which immediately make this metal available in a large way for use in automobiles, aeroplanes, etc. Such matters as these, where a metal has conferred upon it entirely novel properties and thereby enters an immense new field of usefulness by the addition of very small amounts of some other metal or metals, belong in the field of those things that cannot be predicted by existing scientific theories. The only way such discoveries can be made is by patient and careful application of cut-and-try, and, when one considers that the number of possible combinations runs literally into the hundreds of thousands, it will be seen how much work is open in this field of "dilute alloys." It is said that the application of copper to steel, which has grown into the immense industry of making certain types of non-corrosive steel, was somewhat of an accidental discovery, occurring in this way: There was a bridge in Mexico which had not been properly protected by paint and which had still resisted corrosion to a very unusual degree. An analysis of the metal used in the construction of this bridge revealed traces of copper and the following up of this result eventuated in the discovery that copper, within certain limited percentages, does impart to steel marked resistance to corrosion. It may be predicted that in the next few years the development of new types of alloys along the above general lines will exert a tremendous influence on certain industries and very especially on the motor-car industry.

The modern motor car as it stands to-day would not be an actuality were it not for the advances made in the last two decades by the chemist in giving to the industry various useful steel alloys and needed steel treatments, together with certain other alloys, the use of which is essential in building a car that has the necessary lightness and at the same time the requisite strength. I anticipate, however, that such tremendous improvements will be made along these general lines in the next few years that the car of the next decade will be entirely different in its materials of construction. Probably new alloys of aluminum of sufficient cheapness will be developed for many parts of the car and new types of steel of strength tests away beyond those now in use will follow, so that, while the future car will be stronger and will stand up better than the car of to-day, it will be very much lighter in weight and can be built more cheaply than the cars of the present day. This is but an example of what can undoubtedly be done in one limited field and similar advances will be made in practically every branch of chemical and mechanical technology. In the motor-car field, there is bound to come a closer coöperation between the chemist and the automobile engineer in solving the problems connected with the efficient utilization of liquid fuel in the internal combustion engine. The so-called gasoline problem is at present a very acute one. There is a demand for gasoline substitutes, for better grades of gasoline on the part of the automobile industry, and a feeling that somehow or other they are not obtaining from the petroleum industry what they should. The world's production of crude petroleums yielding gasolines is stationary or is actually waning, and our petroleum corporations are really endeavoring to meet the urgent market requirements. The immediate solution of the problem is, in my opinion, not in the discovery of substitutes for gasoline, but in effecting the coöperative efforts of the research chemist and the automobile engineer to devise engines and carburetors which will efficiently utilize a very large proportion of the fractions obtained from crude oil, including both the gasoline and kerosene fractions. There is no question that this can be done and that it will be accomplished. The staff in a magnificently equipped laboratory erected at Dayton, Ohio, by some far-seeing industrialists, is hard at work on the very fundamentals of this problem and undoubtedly other research organizations will also engage in similar inquiry. The day is passed when great discoveries and noteworthy improvements in any particular line of manufacture are made by some one man or even by some one organization. Usually many organizations are simultaneously engaged in the investigation of some general problem and the results obtained by all are gradually fused into an advance of technical importance.

The general theme of this article has been to endeavor to demonstrate that industrial research is remuneratory. It should be thoroughly understood, however, that there is one qualification to that statement: It should be expressed, *industrial research properly done pays*. The question of method in research is at this time an exceedingly important one, and I am convinced that unless research is appropriately conducted it is very likely to result in failure. Industrial research is, in fact, a very specialized business. One prime idea in the foundation of the Mellon Institute was to educate American manufacturers to the realizable functions of properly conducted industrial research. The general method in use at that research institution is by means of what we term the "small-scale plant plan." When a new problem is undertaken, everything related to the solution of that problem is first thoroughly worked out in the laboratory. This is what might be called the "test-tube stage" of the solution of the problem, and, when it is solved in that stage, a small-scale plant, using the same materials as the future commercial plant and of the same general type of construction, is erected and the manufacturing and engineering difficulties are met in this small-scale plant at a very much less cost and very much more rapidly than could possibly be worked out in a full-sized plant. When all these technical problems have been solved in the small-scale plant, the manufacturer is justified in spending the money required to build a full-sized unit; but until that is done the construction of the large commercial plant is apt to be a complete waste of money. It might be expected that this last statement would be so nearly axiomatic among manufacturers that it would not need to be made; but when we see throughout the country very numerous examples of plants which prove to be utterly unsuited for the purposes for which they are built, we know that it is not evident to all of the inexperienced. To proceed from the so-called test-tube stage of research directly to the commercial plant is almost certain to result in failure. The general method outlined is the one which has been successfully developed in the Mellon Institute during its six years of service to American industry and is the procedure employed in some modification or other by all important industrial research laboratories, both here and abroad.

Finnish and Swedish Railway Construction

ACCORDING to a recent issue of *Mercator* (Helsingfors), the construction plans for linking the Finnish and Swedish railway systems have been drawn up with a view to the completion of the work by the autumn of 1918. The bridge over the Tornea River, between Tornea and Haparanda, is to be a single-track bridge, but in view of the fact that the Russian railroad gage is wider than the Swedish two sets of rails will be laid. The bridge can thus be used by both Russian and Swedish rolling stock, though not at the same time.

The bridge is to have a swing section. According to the present proposals, the bridge will comprise eight spans—two spans of 40 meters (131 feet) and two of 60 meters (197 feet) on the Swedish side of the frontier, and two spans of 60 meters on the Russian side, with two spans for the swing section, each having a free span of 30 meters (98 feet). The total length of the bridge will be 405.24 meters (1,329.52 feet).

Rapid Transit in the Factory

The Contribution of the Conveyor Belt to Twentieth Century Industrial Efficiency

NOW and again it is desirable to pause in the round of chronicling new and ingenious devices as they come along, and to ask ourselves just where the general stream of progress is taking us. When we thus formulate into a definite body what have been mere stray items of information, we are as likely as not to find that a mild sort of revolution in our way of doing some particular thing has come about right under our unsuspecting noses.

Such a revolution overtook the business of long distance transportation many years ago. The process was repeated in the slow but steady advance of the motor truck to dominance in the field of delivery. And now we find that in the domain of indoor handling of goods we are squarely in the middle of another upheaval.

But a few years ago such work was invariably done by hand. A small army of boys was employed about our factories, hauling trucks or packing material about by hand. To-day all this is changed. The instrument which has wrought the transformation is the conveyor belt. Its flexibility, its variety of form, are amazing. Few indeed are the men who can hope to tell the belt engineer, "Oh, yes; but *my* business is different." We show here a few typical installations, but it must be understood that they are merely typical—that they are not in any degree exhaustive of the possibilities.

Unloading barrels of cement by conveyors

Closer view, showing the cradles

Some months ago we described a comprehensive conveyor system in use by the Post Office Department at Grand Central Terminal, New York. We pointed out the great economy of time and labor in the external handling of mail, from the trains to the post office on the upper floors of the Terminal building and back to the trains again. Another angle of efficiency is demonstrated by the recent installation of conveyors in the Ferry Station Post Office, San Francisco. Here the emphasis has been on internal handling.

The geography of San Francisco necessitates ferriage across the bay of nearly all mail, outgoing and incoming. This means that fully 80 per cent of the mail handled at San Francisco enters the Ferry Station Post Office. It flows in a steady stream, and any system to handle it must work continuously and expeditiously. When an overland mail delivers a thousand sacks, these must be quickly opened and got out of the way without causing congestion.

Incoming mail is delivered at the northeast corner of the post office building. It is unloaded onto the conveyors, of which a number are provided, for different classes of mail matter. For the most part these conveyors are belts with steel chutes and slides so arranged that sacks or even single parcels may be diverted at desired points. With almost human intelligence the different classes of mail are shunted from one line or belt to another, at the will of the operator in charge. These conveyors bring the mail directly to opening tables. Here the sacks are opened and worked into their different directions and divisions. The service of conveyors relieves the clerks of all thought and labor in procuring the sacks from the trucks; they flow in continuous streams to the tables.

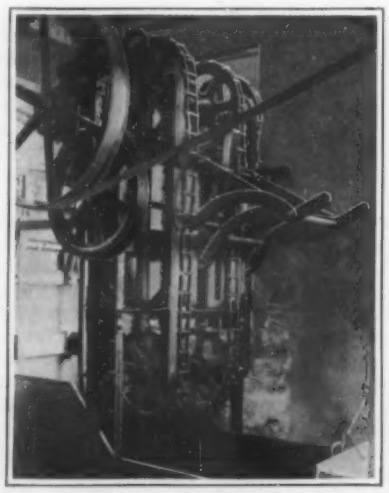
Special equipment for parcels post matter is provided, and the bulky packages and heavy sacks of this division are handled with great ease. There are four long lines of parcels post conveyors. All packages are carried directly to the opening table. The clerks stand on the floor between this table and the conveyors radiating from the far end, distributing the parcels post matter onto the conveyor which will take each particular package to the rack of sacks destined for the appropriate section of the country. The arrangement of these conveyors is most compact; the radiating plan, never before used in such systems, gives eight separations in very little space, and at the same time allows plenty of room for the racks of sacks at the other end—a feature of importance.

So much for incoming mail. The outgoing mail collected from street boxes is brought to another side of the building, and the sacks carried on a conveyor to a mezzanine floor. Here they are opened and various classes of mail distributed by hand into different chutes which take them directly to cancelling machines and distributing racks. A system of overhead belts carries this mail back and forth till it has been cancelled, sacked, and is ready for delivery to the outside of the building, where trucks are waiting to take it to the ferries.

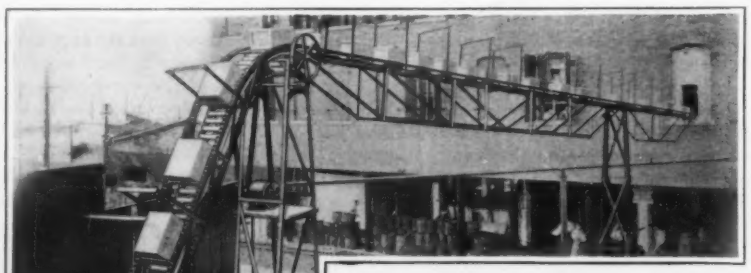
The mail taken into the public lobby of the post office falls from the drops directly onto an inclined belt elevator, always running, which carries a single letter or a bundle, as the case may be, up to the horizontal belts overhead, where it merges with the mail from the carriers' collections, and passes with that to cancelling machines or facing tables. The old method was to put a basket under the drop, pushing it across the floor to the tables when it was filled. The conveyor provides a continuous movement of mail, avoiding congestion at busy hours and moments. A similar disposition is made of packages handed in at the window of the parcels post division.

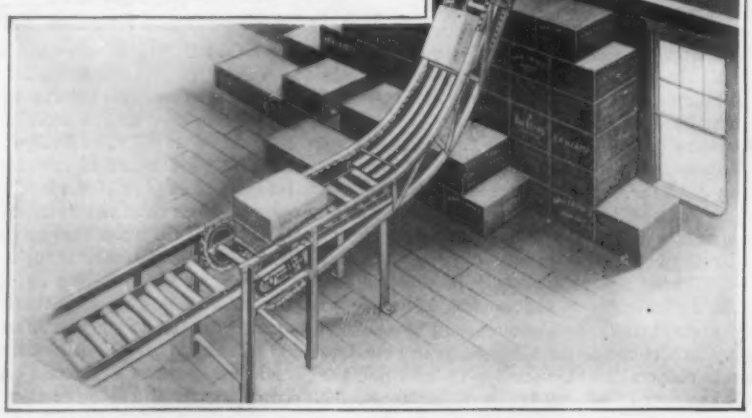
The building at Ferry Station was especially designed for the use of this conveyor system. The actual number of men saved by the installation is problematical, for business has greatly increased since the conveyors were completed. Perhaps the greatest consideration in the minds of the officials who fostered the installation was the continuity of service which the system affords, and the further elimination as far as possible of the human element in the handling of mail. The old delays in waiting for trucks, for baskets to be removed, for men to return to their posts, have been entirely eliminated. The great gain in floor space alone is regarded by the authorities as ample excuse for the conveyor. And of course results are typical of those attained by use of conveyors in all lines.

We have just remarked that the San Francisco Post Office was constructed with special reference to the installation of conveyor belts. This is really a noteworthy feature of the conveyor system; it is a fact that many, if not most, conveyor installations are made in new or remodelled buildings, and that frequently the saving to be effected by them is a potent factor in clinching the decision to rebuild. But rebuilding, or even reconstruction, is not always a prequisite to their use. A prominent packing house recently concluded that its procedure of manufacturing its packing cases in one building, loading them onto a two-horse-truck, and

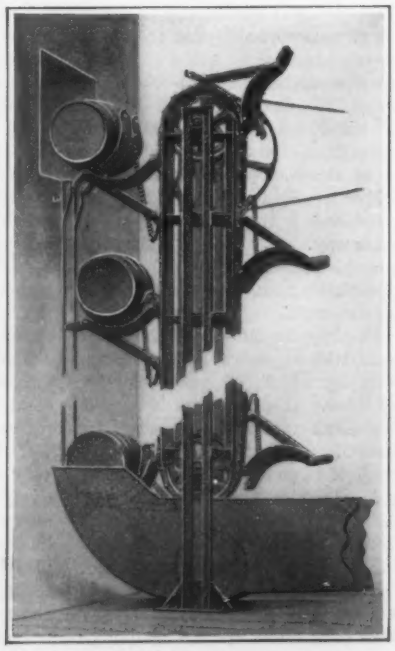


The barrel hoist from the open side, showing conveying arms going down

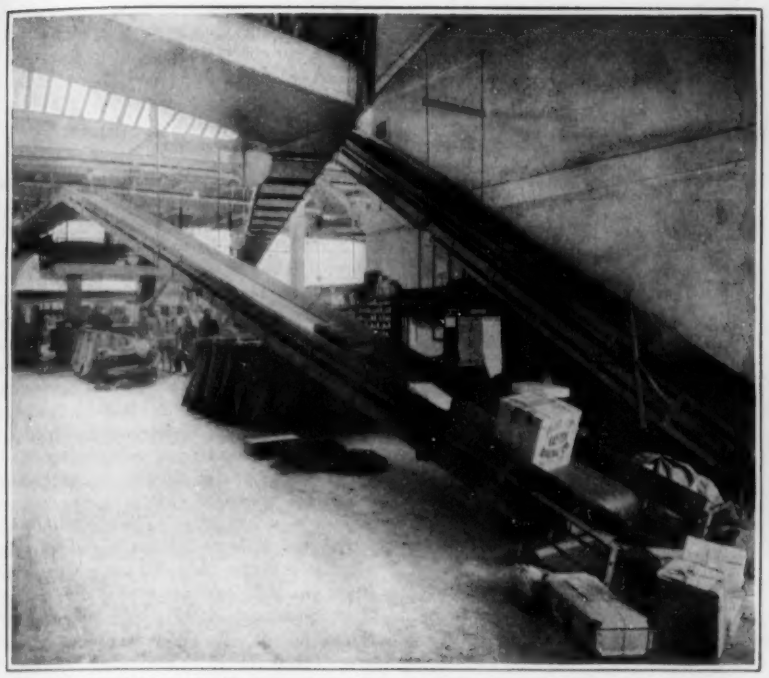




Conveying cases from the box factory across the street and over the railroad to the packing house



The barrel hoist in operation, showing how it picks up and delivers its load



Incoming mail from the ferries goes on these conveyors to opening and facing tables

At the other end of the building. Sorting the mail and distributing it into sacks

carting them around two blocks from the back door of the box factory to the back door of the packing room, was a wasteful business. It was not possible to move the box factory to a more convenient spot; but the problem of doing away with this antiquated routing was nevertheless solved, in the manner indicated in our cut.

In the foreground we have the box factory, where the packing cases are made. On the other side of the street and of the railroad is the packing house proper. The boxes are loaded onto the conveyor, carried up to the roof of the box factory, across the tracks and the street, and set down in the packing room at precisely the spot where they are wanted. Not only that, but most of the work is done by gravity. A one-horse-power motor is necessary to raise the boxes to the highest point of the system, at the top of the stand above the roof of the box factory; but from here they just drift along. They are carried to a sufficient height in the first place so that their weight does the rest, and brings them, in a steady stream, to the packing tables. In accordance with this plan, it will be seen that the endless chain-belt, which is used to raise the boxes to the top of the little tower, stops there and returns, so that for the rest of their journey the boxes simply roll along over fixed rollers.

Using space from the ceiling down by aid of a portable conveyor belt

Another valuable and ingenious installation is one recently made by a large oil works in Milwaukee for handling empty barrels from the wash-house to the filling room. The barrels after washing are rolled into a chute, which delivers them at the foot of a conveyor-elevator, as indicated in the picture. They are then raised through a distance of several yards and thrown out into a second chute, down which they gravitate to their destination.

The distinctive feature of this elevator is the curved metallic arms attached to the rotating belt These are so constructed that as the belt carries them down into the mouth of the chute they catch hold of the barrel waiting there, and, rolling it around the curved head of the chute, presently are under it and able to lift it bodily with them as they proceeded on their upward way. Just as the arms with their load reach the level of the little opening in the wall leading to the filling room chute, a tripping mechanism is thrown into action, retarding the tips of the arms until the barrel rolls off and goes spinning merrily along down the chute.

This system operates much like the good old chain-and-bucket pump, only, instead of each bucket bringing up its mite of water, each pair of arms brings up its barrel. The operation is quite automatic. If the supply of empty barrels fails for a time, the elevator goes right on like any well-behaved conveyor belt, running empty on the up side as well as the down, until the barrels begin to flow again. Its capacity is 120 barrels per hour; it is driven from the regular power system of the building, requiring about one horse-power; and as will be seen at once, it can be adapted to practically any conditions where it is desired to transfer barrels from one point to another.

All these examples of the conveyor are fixed. But small, portable conveyor belt devices are by no means out of the question. One type is that used in the piling of boxes and boxed goods.

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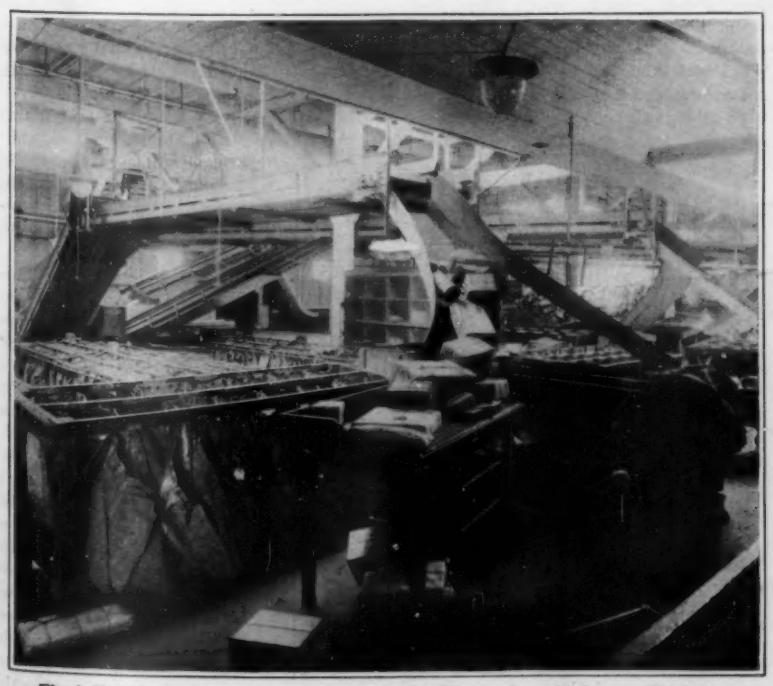
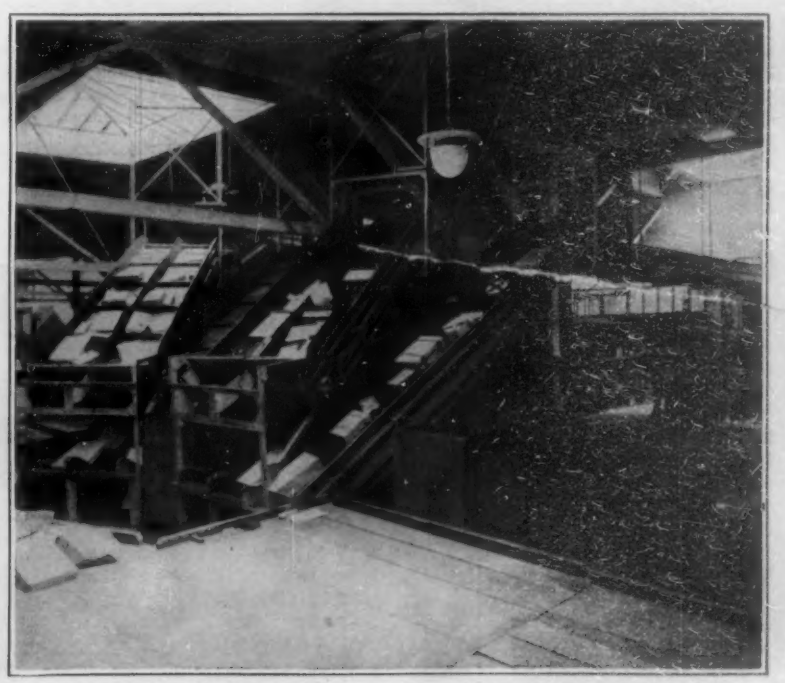


Final distribution point for out-going mail. The sacks which are filled from these conveyors go to the trains



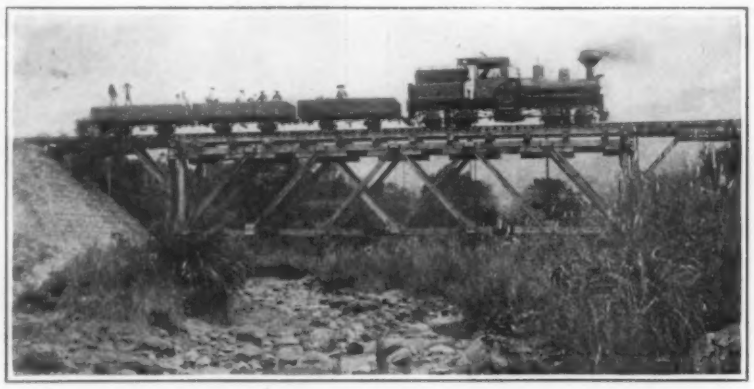
Radiating conveyors which remove out-going mail from the parcels post sorting table to the final distribution point

How the Government Helps Foreign Trade

The Collection of Authentic Information by Our Special Agents and Commercial Attachés

By Hon. Edward Ewing Pratt, Chief of the Bureau of Foreign and Domestic Commerce, Department of Commerce

MOST Americans understand how the Government helps the farmer through the Department of Agriculture, but comparatively few understand how the Bureau of Foreign and Domestic Commerce, of the Department of Commerce, renders similar assistance to exporters and manufacturers. As foreign trade is playing a tremendous part in our present prosperity, and as our prosperity after the war will depend in large measure, if not entirely, on our success in foreign markets in the face of desperate competition, it is essential that all business men engaged in foreign trade or likely to be so engaged, should familiarize themselves with the service the Government has provided for them.



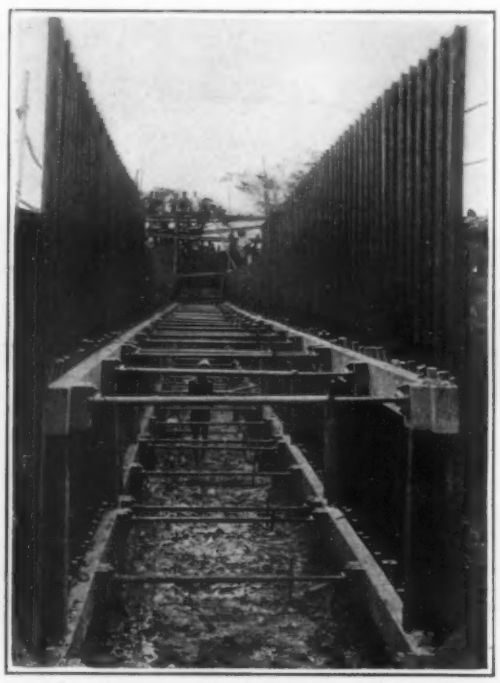
American high-geared locomotive in Formosa

To put it very broadly, the business of the Bureau of Foreign and Domestic Commerce is to collect information about foreign trade and then disseminate that information among American exporters and manufacturers. Americans, rightly, want only first-hand, up-to-date information on this subject, so it is necessary to have representatives on the ground, and these representatives may be put into three classes—the special agents, or trade commissioners, who are traveling specialists; the consuls, by arrangement with the State Department; and the commercial attachés, stationed permanently at the principal capitals. The information collected by these representatives is made available to the business public through the daily *Commerce Reports*, through special bulletins, through the district and coöperative offices in the principal American cities, and through personal interviews with returned representatives.

It is only recently that more than two or three special agents, or trade commissioners as they are sometimes called, have been on the Government's payroll at one time, and it is only recently that a systematic effort has been made to get the best available men for the positions. Since the war started there have been some twenty of these specialists in the field at all times, and they have been men selected with the greatest care. The work of some, perhaps, has not been the best imaginable, but in passing on the merits of such work the exacting demands of the position should be taken into consideration. If it is decided, for instance, to make a study of the South American markets for electrical goods, it is necessary to find a man who is not only familiar, in a technical sense, with the line and with the methods of marketing the line, but who can speak Spanish, and who can write a good report on what he learns. And for South American investigations particularly it is necessary that the appointee be able to make a pleasing impression in a social as well as a business sense. The combination is hard to find, yet the man finally selected for just that investigation is an electrical engineer who speaks Spanish, has had plenty of experience in writing for publication, and has had five years training in the export department of one of our greatest electrical concerns. To such a man the Government pay is not the only or the principal incentive. He realizes that his experience will be a great asset to him in his profession when his reports are completed and he has severed his official connection with his Uncle Sam.

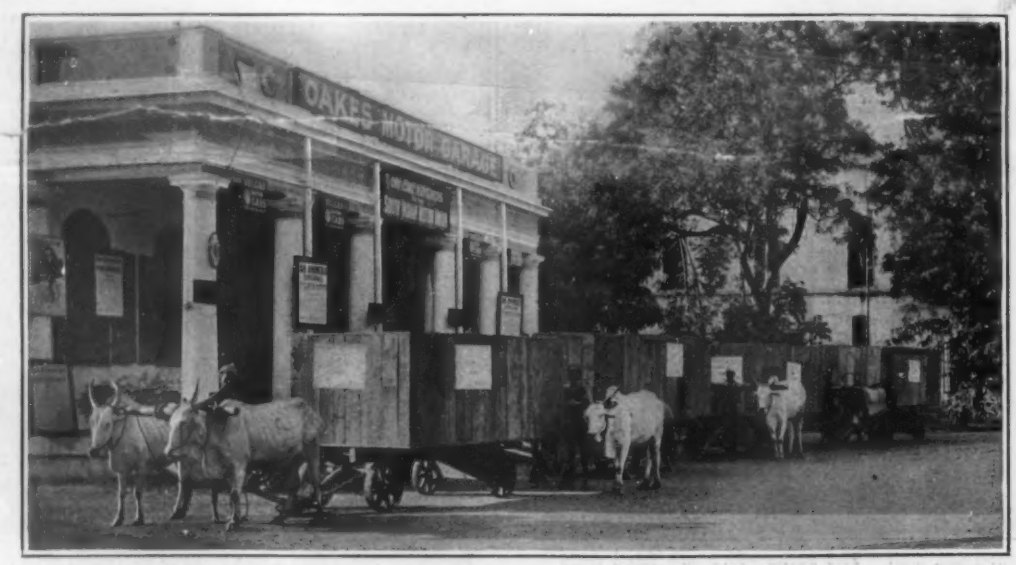
To find men of this caliber a searching examination system has been developed. Applicants are first of all required to state in writing what they consider their qualifications for the position to be filled. Those who are not obviously unfit are then given a written examination by the Civil Service Commission, which usually eliminates a large percentage of the candidates, but none who has evident qualifications. The successful applicants are then invited to Washington for an oral examination given by a board composed of Civil Service and Bureau officials and often representatives of the industry in whose behalf the investigation is to be undertaken. It is practically an impossibility for an unsuitable man to pass both examinations.

With agents selected in this manner the Bureau has recently undertaken investigations of ports and transportation facilities in the Far East; ports and markets for coal in South America; mineral resources of the Far East; electrical goods in the Far East and in South America; railway materials, equipment, and supplies in the Far East; agricultural implements and machinery in the Far East and in South America; construction materials and supplies in



American steel sheet piling used in India

South America; textiles in South America; boots and shoes in the Far East and in South America; cotton goods in the Far East; paper, paper products and printing supplies in South America; wearing apparel in the Far East; investment opportunities in South America; fruits and nuts in South America; and a number of others of lesser importance, though still of great value.



American motor cars arriving at a garage in Madras

Most of our investigations are concerned almost entirely with the markets for American goods, but there are some important exceptions. The agent who has recently been selected to make a study of ports and transportation facilities in the Far East, including Siberia, will not be much concerned with markets. He has three definite objects in view. The first is to learn all he can about the equipment of the ports, the docks, storage facilities, terminals, and the railroad facilities for carrying goods inland after they have reached the ports. In this connection he will also make a careful study of the methods of handling freight. All of this, obviously, is intended for American shipping companies and exporters, to assist them in deciding upon shipping routes. His second object will be to gather information on port and railway improvements and extensions that are contemplated or likely to receive consideration in the near future. Such information will be put in the hands of American engineers, contractors, and manufacturers to assist them in getting a share of the work. As the agent is a consulting engineer of recognized standing it is reasonable to suppose that the information gathered under this head will be accurate and of practical value to the interested American firms. A third object this agent will have in view will be to keep a record of new ideas and devices in port construction, to be made available to port authorities in the United States. There have been some interesting recent developments in modernizing port facilities in the East.

Two agents are now in the field studying the prospects of selling American agricultural implements and machinery and both have proved the wisdom of searching thoroughly until men are found who have a practical knowledge of the line. They have been writing excellent reports and both are so well versed technically in agricultural machinery that they have been able to clear away many little misunderstandings where American equipment was not thoroughly understood. While visiting a large estate in Argentina, our agent learned that a new American plow was on trial on a neighboring estate and was not giving satisfaction. The agent went over at once to see what the trouble was, and found that the plow was being used just as delivered and needed readjusting. As no one else seemed up to the task of correcting the fault, the agent took off his coat and did it himself. Properly adjusted, the plow worked perfectly. On another occasion he was able to render valuable assistance to an important Brazilian importer who handles American equipment. In filling an order for a large tractor for this firm an American manufacturer sent down a new-model kerosene burner, without instructions for using. The importer made arrangements for a public demonstration before he discovered that he could not operate the tractor. In desperation, he sent for the Bureau's agent, then at work in a nearby city. The agent arrived on the scene in a few hours, initiated the importer into the mysteries of the kerosene burner and a number of other novel features, and the demonstration went through without a slip. In addition to estimating the importance of the various markets for implements and machinery, these agents consider it their duty to ascertain whether the farmers are handling their crops to the best advantage, and if not to suggest improved methods whereby the producers' profits, and consequently their purchasing power will be increased.

One of the newest appointees is a trade commissioner who will study the mineral resources of the Far East. This investigation is expected to bring to light opportunities for the investment of American capital, which will insure future orders for mining equipment; it will call attention to present opportunities for the sale of such equipment; it will make clear what competition may be expected from producers of minerals in the East; and it will also furnish some information as to the quantities of certain minerals

(Concluded on page 291)

German Sniper's Helmet

RECENTLY a Canadian officer came across the odd steel headgear which appears in the accompanying illustration, while clearing out a captured German trench. The steel helmet proper is of the usual pattern worn by the German troops in first-line trenches as a protection against rifle fire and shell splinters, and is the German answer to the French and British helmets. However, the truly novel feature is to be found in the Krupp steel armor plate, which is attached to the helmet in the manner shown, supplemented, if necessary, by a leather strap. This armor plate is a quarter of an inch thick, and is said to be ample in protecting the wearer's head against direct rifle fire. It is only worn while the sniper is on active duty.

This one-quarter inch thick armor fastened to the usual helmet protects German snipers while on duty

Pneumatic Tired-Road Skates That Make Skating More Than a Sport

THE great limitations of the ice and roller skates have caused outdoor skating to be indulged in for only a few months of the year, and then only by way of sport. Yet roller skates, if the present limitations were removed in large part, would soon prove an ideal means of travel for the multitudes; for who would not welcome this sort of seven-league boots, which would enable three times the distance to be covered with the usual walking effort?

A new form of skate invented by Charles H. Clark of New York City, who in 1904 was the Pacific Coast champion wheelman, appears to have solved most of the roller skate problems existing heretofore. That the inventor thoroughly understands the possibilities of this mode of locomotion is borne out by the fact that his skate can be used almost anywhere and at any time. Further, he is skating regularly in New York City on the streets.

The present skate, with its ball-bearing, pneumatic-tired wheels, runs easier on a good road or street than an ice skate will slide on ice, according to the inventor; besides, it will climb any hill or go safely down any hill. There are two 9-inch wheels on each foot, which are located on opposite sides of the foot, the front wheel being on the inside of the foot and the rear wheel on the outside so that they do not interfere with any movement of the legs, common to either ice or roller skating.

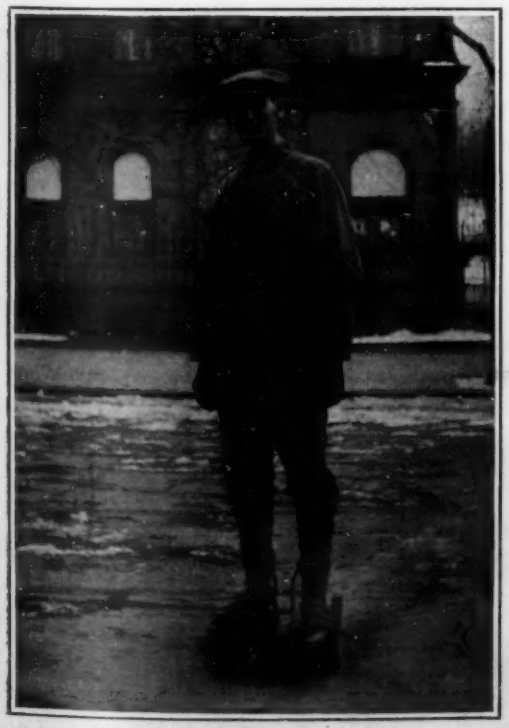
A brace on the outside of the leg is journaled to the foot rest, while the upper end is attached to the ankle, relieving the ankle of any strain whatsoever. This brace also acts as a brake arm to set the band brake on the rear wheel. In earlier models the inventor used a roller tire brake and placed the brace on the side of the leg, but both these expedients proved unsatisfactory. In the present skate either brake is operated by simply pushing either foot forward, as a person would naturally do at any time he wished to stop. The tires used for the wheels give sufficiently to allow the skate to be readily steered, and on the whole the skate operates very much like an ice skate. However, the feeling is quite different, since the skater glides on a cushion of air and feels no jar. He simply swings from side to side, raising first one foot and then the other from the ground. The present road skate, according to its inventor, will be made in various sizes, and the heaviest man-sized model will weigh approximately four pounds each, despite its substantial construction.

A near view of the pneumatic-tired road skates, which are provided with brakes operated by the braces

One great advantage a skate has over any other form of wheeled vehicle is that a person can carry the skates with him to the locality where he wishes to skate, thus saving the journey on skates to and from that locality. Furthermore, a skate can be taken into any building; in fact, it can be carried about without great inconvenience.

As a foot-propelled vehicle the skate is most efficient because the propelling force is applied direct to the ground, hence no transmission system with its attendant losses is necessary. The skate is noiseless, regardless of the nature of the surface skated over, whether it be rough or smooth. Like most pleasure vehicles the improved skate will eventually be used for business purposes to a more or less extent, believes the inventor; and it is even possible that it may be extensively used by armies for the rapid transportation of soldiers in certain favorable localities. Before a skate of this kind could be adopted in a country like the war zone in France, where the roads are next to impassable, it would be necessary to build either permanent or portable skate courses in the localities where the troops are to be moved.

Over such a course a soldier could skate at about three times the speed at which he would ordinarily walk, and with an equal amount of exertion. Such a skate course would no doubt last for years, and the idea could be worked out in any locality so that persons could skate to and from their places of business since it often happens that good streets are not availabe to skaters because of congested traffic.



By means of these skates one can travel three times as far with the same amount of effort as in walking

Growing Cotton in the French Colonies

SO recently as 1860 the production of cotton in Egypt was only 23 million kilograms (about 50 million pounds) annually. In 1910, thanks to the wise policy of England in fostering its cultivation, the yield had become no less than 940 million kilograms (2,068 mil. lbs.), constituting the principal source of revenue of the country. Russia instituted the same policy in Turkestan in 1884, and it is now estimated, says *Je Sais Tout*, that within ten years the textile industries of the country will be independent of foreign imports of cotton. These instances give point to a proposed law recently offered in the French Chamber, by M. Barthe, deputy from l'Heravlt, having for its object similar organization and promotion of the cultivation of cotton in all those regions of Morocco adapted to this purpose.

The Academy of Agriculture has also studied and debated this project and finally voted unanimously in favor of urging the proper authorities to encourage the intensive cultivation of cotton in the colonies, thus eventually "saving France an annual expense of four hundred million francs."

We recommend these propositions to the consideration of our friends among the cotton-growers of the South, who are already, we note, beginning to appreciate the importance of diversified crops.

A Noisless Trench Gun

AMONG other things the Germans, anticipating modern trench warfare, had provided themselves with a fair number of trench mortars at the beginning of the present war. The French and British armies, on the other hand, were totally unprepared in this respect; and the first few months of the war witnessed the French soldiers in particular improvising trench artillery from spent cartridge cases, tin cans, old boxes, and other articles salvaged from the debris on the battlefield. Not slow to grasp the importance of trench artillery with the opposing lines a few hundred feet apart at many points along the western front, the Entente troops are now equipped with trench artillery comparable, if not surpassing, that of the German forces.

Of late the French forces have been making use of a pneumatic bomb thrower which is shown for the first time in the accompanying illustration. Unfortunately it has not been possible to obtain details concerning this interesting artillery piece, hence such description as is possible here must be based on a close study of the illustration.

The pneumatic trench mortar, it appears, consists of a breech-loading barrel to which is attached a compressed-air tank, the latter being charged by means of a simple handpump fitted with a pressure gage. It will be noted that the tank is hinged to the barrel at two points, in such a way that when it is swung into the firing position—above the barrel—an extended disk-like member covers the breech end of the gun, acting as a sort of breech block. The mortar is discharged by admitting the compressed air from the tank to the breech. The main advantage of the pneumatic bomb thrower is to be found in its silent operation; for the enemy, unwarned of the hurling of a trench bomb, is caught unawares by this most destructive engine of war. While it is true that the pneumatic trench mortar effects a considerable saving in eliminating the use of powder, this is insignificant in warfare on such an extensive scale as that of the present conflict.

A handpump furnishes the propelling charge for this pneumatic trench gun

The Motor-Driven Commercial Vehicle

Conducted by VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

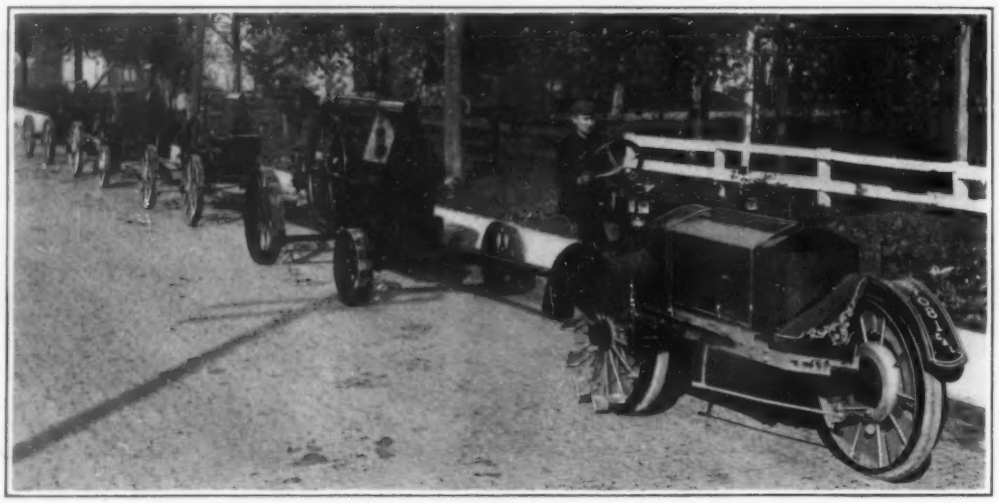
Electric Tractor with Novel Drive

IT is conceded that the work of hauling and delivering can be done more economically, as a rule, by power-driven than by horse-drawn vehicles, but in order to do this successfully the vehicles must be designed and constructed especially for the work they are to do. In certain classes of delivery work it is cheaper to use electric trucks or delivery wagons than it is to use forms propelled by internal combustion engines. Similarly when hauling by tractor there are certain tasks that can better be performed by an electric tractor. A novel electrically operated tractor having a hauling capacity of 15 tons is illustrated herewith. One view shows the complete vehicle while the other is a rear view of the chassis showing the rear axle used. This differs from conventional practice in that the driving motor is concealed in the large hollow rear axle and that all of the driving elements are completely enclosed. One electric motor is used which is direct connected to the differential gear. Two driveshafts extend from the differential sockets into the center of each hollow rear wheel and each driving shaft carries a spur pinion at the wheel end. The power is transmitted from the small pinions through two idler spur gears in each wheel, these idler gears being rotatable on their own axes but not capable of epicycle movement as in the usual planetary gear system. The idler gears mesh with internal spur gears which are fastened to the inside of the tire rims. The power of the motor is therefore transmitted from the pinions on the end of the axle shaft to the wheel by means of idlers and rim gears.

This construction not only provides for a fully enclosed and dirt-proof power plant but also means that all moving parts contributing to the power transmission will remain in permanent alinement. Even though the parts are well housed they are very accessible. The power that is developed on the center line of the axle is transmitted in balanced opposite directions to each wheel rim. The use of hollow wheels permits of having all working parts constantly operating in a bath of lubricant. Naturally this reduces wear and makes for superior endurance and absence of noise. The wheel sides are formed of two pressed steel disks having radial corrugations in the form of spokes, which taken in combination with the dished form of the disk gives the wheels much greater strength than would be possible with wooden wheels, as well as securing perfect enclosure of the drive gearing.

In order to conserve electric battery current both front and rear wheels and the motor armature are mounted on annular ball bearings. Taper roller-bearings are provided in the top and bottom of the front axle spindles to make steering very easy. Semi-elliptic springs are used throughout, and a triangular reach of channel section steel extends from the extremities of the front axle to the chassis frame where the two arms unite in a ball joint. This provides a substantial bracing for the front axle, takes care of all shocks produced by road irregularities without any twisting or bending strain in the chassis.

The battery is carried in a substantial wagon body, on top of the main frame of the vehicle. The battery is readily accessible by lifting centrally supported hinged covers having refrigerator type latches. A lead-sulfuric acid type battery is furnished unless otherwise specified by the purchaser, but the battery boxes are of sufficient size to accommodate any make and thus the type of cell is furnished that is best suited for each particular service. An ampere hour meter is provided which shows at a glance how much current has been consumed and how much is available for propulsion. This meter makes it easy to keep accurate records of current used per mile, trip, day, week, month or year so that the owner can determine the exact cost of current for any given period. The control is through the usual form of controller lever which gives four speeds forward and the same number in a reverse direction. The brakes are of the external constricting type and are of large diameter so they are very powerful without requiring the expenditure of much effort on the part of the driver. The mileage per discharge of battery varies with the type of battery used and is from forty to sixty miles.



Tractor hauling a train of portable plants from factory to freight yard

Delivering by Tractor

THE maker of a medium weight agricultural tractor has a novel method of testing the finished product as relates to its hauling capacity. In addition to tractors, portable gasoline farm-power plants are manufactured and when a shipment is to be made of these, it is a simple matter to attach the tractor to a train of four or five of these vehicles which otherwise require one or two horses to draw them and rapidly and economically transfer them from the factory to the freight yards. The tractor is a type adapted for field or road work and has rubber tires on all three wheels for use on hard roads and an attachment of driving lugs to the extension rims of the rear wheels so that ample traction is secured when operating in the field. The arrangement of the driving lugs is such that they are kept out of contact with hard road surfaces by the rubber tires of the wheels. In soft ground the tires sink in and give the lugs an opportunity to secure a firm grip. Steering is effected by the single front wheel through the usual worm reduction steering gear of the automobile type. The engine is a four-cylinder, four-cycle pattern, speed changes being obtained through a friction drive mechanism and final drive being by means of the conventional spur gearing to the rear wheels. Owing to its light weight this tractor is very economical to operate and yet the machine is heavy enough so as to secure full tractive power of the engine.

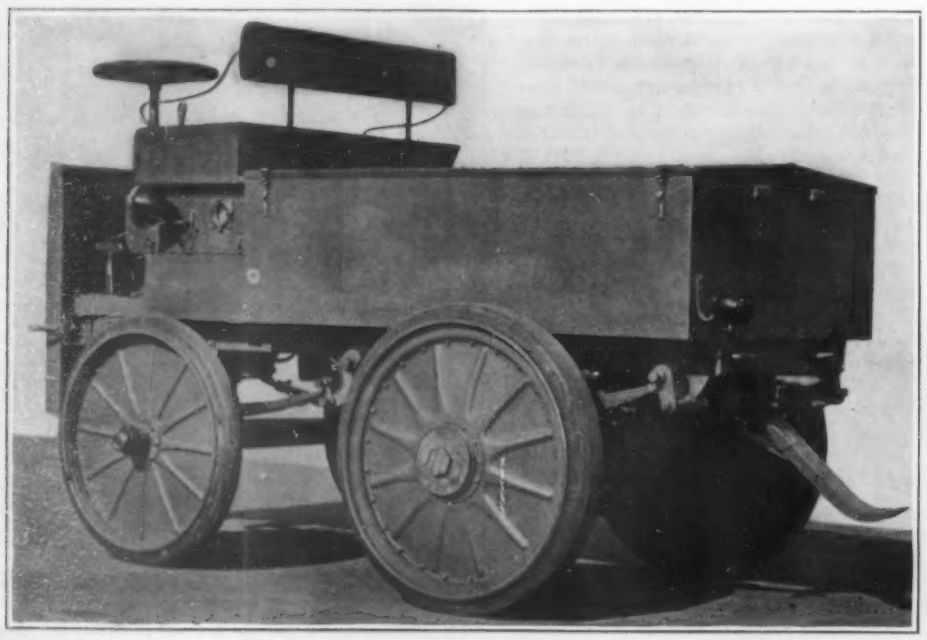
A motor tractor of this type is especially adapted for use by the small farm owner because it is capable of efficient work on the road when its duties in the field are completed.

A Snow Plow Which Works Both Ways at Once

A UNIQUE combination snow plow for use either on city or interurban electric lines has been worked out by a railway official in Spokane, and is now in operation. The new machine, which weighs 70,000 pounds, is equipped with a plow at one end and a sheer at the other. The plow throws the snow to either side of the track, while the sheer, used on city streets, throws it to one side only. The plow is fitted up inside with electrical stoves and heating devices for the comfort of the crew in zero weather.

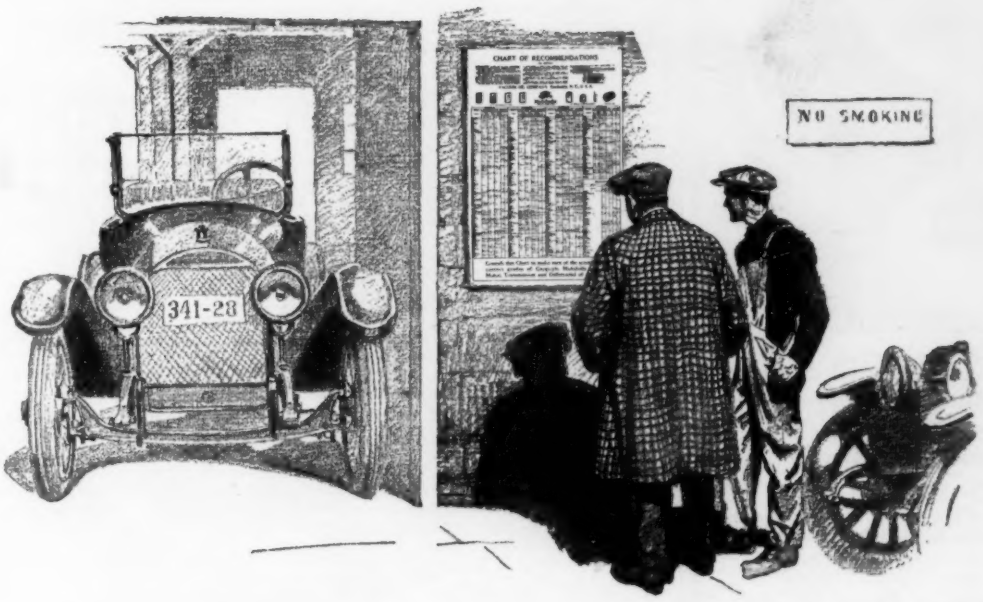
Aero Sleigh for Alaskan Mail

AN aero sleigh equipped with an aeroplane engine has been constructed at Spokane, Wash., according to the *Spokane Chronicle*. The sleigh, driven by a large propeller, is capable of traveling over any depth of snow at a speed as great as 75 miles an hour. It has been built and patented by Daniel E. Riley and is to be used in Alaska for mail service. The machine leaves a cloud of snow in its wake as it is blown along at express-train speed.



Balanced drive electric tractor of 15 tons hauling capacity. Note the distinctive rear axle

Make this chart your guide



Look for it on your dealer's wall

Your oil runs low. You stop for a fresh supply.

You now come to a vital question. What oil will the dealer pour into your oil-reservoir? Will it be just "oil"—or will it be the correct lubricant for *your* engine?

Among thousands of dealers this is what happens:

The dealer recognizes the make of your car—and the year's model. He runs his finger down the Vacuum Oil Company's Chart (shown above in miniature) until he finds your car's make and model. Then he supplies you with the grade of Gargoyle Mobiloils specified for your car by the Chart. This oil will effectively seal your piston rings against power-waste, gasoline-waste and oil-waste.

Why are thousands of dealers placing such reliance in this Chart?

Experience has taught them that something like 50% of all engine troubles are due to incorrect lubrication.

They realize that scientific lubrication is a problem for specialists. Since the dealer has neither time nor equipment for studying this intricate subject he draws on the experience of a recognized authority.

That is why you find on his walls the large Chart of Recommendations, issued by the Vacuum Oil Company.

If you inquire about the Chart you will find this:

The Vacuum Oil Company for 50 years have specialized in scientific lubrication. Today their world-wide leadership in lubrication matters is unquestioned in scientific circles.

For years their Chart of Recommendations has been recognized as the only standard guide to correct automobile lubrication.

In keeping this Chart up to date, each new model of every automobile is carefully analyzed. This work involves lengthy and painstaking engineering study by the Vacuum Oil Company's Board of Engineers. The recommendations of this Chart are proven correct by repeated practical tests.

But nothing has given dealers such faith in this Chart as their experience with the oils themselves. For no one knows better than the dealer how difficult it is to secure efficient lubrication—and how much efficient lubrication means.

Write for new 56-page booklet containing complete discussion of your lubrication problems, list of troubles with remedies and complete Charts of Recommendations for Automobiles, Motorcycles, Tractors and Marine Engines.

GARGOYLE

Mobiloils

A grade for each type of motor

In buying Gargoyle Mobiloils from your dealer, it is safest to purchase in original packages. Look for the red Gargoyle on the container. If the dealer has not the grade specified for your car, kindly write our nearest branch, giving dealer's name and address.

VACUUM OIL COMPANY, Rochester, N. Y., U. S. A.

Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the world.

Domestic Branches: Detroit New York Philadelphia Minneapolis Boston Chicago Indianapolis Pittsburgh Kansas City, Kan. Des Moines

Correct Automobile Lubrication

Explanation:—The four grades of Gargoyle Mobiloils, for engine lubrication, purified to remove free carbon, are:

Gargoyle Mobiloil "A"
Gargoyle Mobiloil "B"
Gargoyle Mobiloil "E"
Gargoyle Mobiloil "Arctic"

In the chart below, the letter opposite the car indicates the grade of Gargoyle Mobiloils that should be used. For example, "A" means Gargoyle Mobiloil "A," "Arc" means Gargoyle Mobiloil "Arctic," etc. The recommendations cover all models of both pleasure and commercial vehicles unless otherwise noted.

Model of CARS	1917 Summer	1917 Winter	1916 Summer	1916 Winter	1915 Summer	1915 Winter	1914 Summer	1914 Winter	1913 Summer	1913 Winter
Abbott-Detroit	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
" " (8 cyl)			A	A	A	A				
Allen	A	Arc	A	Arc	A	Arc	A	A	A	A
" (Mod. 33-34-35)					A	Arc				
American Six	Arc	Arc								
Apperson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A						
Auburn (4 cyl)			A	Arc	A	Arc	A	A	A	A
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Autocar (2 cyl)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Avery			A	A	A	A	A	A	A	A
" (Mod. 5 & C 1 ton)			Arc	Arc	Arc	Arc	Arc	Arc		
Briscoe	A	Arc	A	Arc	A	Arc	A	Arc		
" (8 cyl)			A	A						
Buick	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
Cadillac							Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	Arc	Arc				
Case	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Chalmers			Arc	Arc	Arc	Arc	A	A	Arc	Arc
" (Mod. 6-40)			A	Arc						
" (Mod. 6-30)	A	A	A	A						
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Chase (air)			B	B	B	B	B	B	B	B
Chase (water)	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Chevrolet	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	A
Cole			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A				
Cunningham					Arc	Arc	Arc	Arc	A	A
" (8 cyl)	A	A	A	A						
Daniels (8 cyl)	A	A	A	A						
Dart	A	Arc	A	Arc	Arc	Arc	A	A	A	Arc
" (Mod. C)	A	Arc	A	Arc	A	Arc	A	A		
Delaunay-Belleville					B	A	B	A	B	A
Detroiter	Arc	Arc	Arc	Arc	A	Arc	A	A	A	Arc
" (8 cyl)					Arc	Arc				
Dodge	A	Arc	A	Arc	E	E				
Dort	A	Arc	A	Arc	A	Arc				
Empire (4 cyl)	A	Arc	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (6 cyl)	Arc	Arc	Arc	Arc						
Federal	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Fiat	B	A	B	A	B	A	B	A	B	A
Ford	E	E	E	A	E	A	E	A	E	E
Franklin	A	A	A	A	A	A	A	A	A	Arc
Grant	A	Arc	A	Arc	Arc	Arc	Arc	Arc		
H. A. L.	A	A	A	A						
Haynes	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (12 cyl)	A	A	A	A						
Hollier (8 cyl)			A	A	A	A				
Hudson			Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
" (Super Six)	A	Arc	A	A						
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
I.H.C. (air)					B	A	B	A	B	A
I.H.C. (water) (2 cycle)			A	A	A	A	A	A	A	A
I.H.C. (water) (4 cycle)			A	Arc						
Interstate	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Jackson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Jackson (8 cyl)	A	A	A	A						
Jeffery	A	Arc	A	Arc	A	Arc	A	A		
" (Chesterfield)			A	Arc	A	Arc				
" Com'l	A	Arc	A	Arc	A	Arc	Arc	Arc	Arc	Arc
Jordan	Arc	Arc								
Kissel			E	E	E	E				
" Com'l	A	Arc	A	Arc	A	Arc				
Kelly Springfield	A	A	A	A	A	A	A	A	Arc	Arc
King					A	Arc	A	A	A	E
" (8 cyl)	A	A	A	A	Arc	Arc				
" Com'l	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Kissel Kar	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" " Com'l	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
" " (Mod. 48)			A	A	A	A	A	A		
Knox	A	A	B	A	B	A	B	A	B	A
" (Mod. 35)	A	A	A	A	A	A				
Lexington	Arc	Arc	Arc	Arc	Arc	Arc				
Liberty (Detroit)	Arc	Arc								
Lippard Stewart	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" " (Mod. 36)	A	Arc	A	Arc						
Locomobile	E	E	E	E	E	E	E	E	Arc	Arc
Marion Handley	Arc	Arc								
" (Mod 6-40)	A	Arc								
Marmon	A	A	A	A	A	Arc	A	Arc	A	Arc
Maxwell	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mercer	A	A	A	A	A	Arc	A	Arc	A	Arc
" (22-70)					Arc	Arc				
Mitchell	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Mitchell (8 cyl)			A	A						
Moline									A	Arc
" Knight	A	A	A	A	A	A	A	A		
Mora (4 cyl)					Arc	Arc	A	Arc	Arc	Arc
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Murray (8 cyl)	A	A								
National	Arc	Arc	A	Arc	A	Arc	A	A	A	A
" (12 cyl)	A	A	A	A						
Oakland	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
" (8 cyl)			A	A						
Oldsmobile			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A						
Overland	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Owen Magnetic	A	Arc	A	Arc	A	Arc				
Packard					A	Arc	A	Arc	Arc	Arc
" (12 cyl)	A	A	A	A						
" Com'l	A	A	A	A	A	A	Arc	Arc	Arc	Arc
Paige					A	Arc	A	A	A	E
" (6-46)	Arc	Arc	Arc	Arc	Arc	Arc				
" (6-36 & 38)	A	Arc	A	Arc	A	Arc				
Pathfinder	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
" (12 cyl)	A	A	A	A						
Peerless	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A						
Pierce Arrow	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" Com'l	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	A	A	Arc	A	Arc	A	Arc	A	Arc
Pullman	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Regal	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	Arc	Arc					
Renault			A	Arc	A	Arc	A	Arc	A	Arc
Reo	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Richmond	Arc	Arc	Arc	Arc	A	Arc	A	Arc	Arc	Arc
Riker	E	E								
Simplex	E	E	E	E	E	E	E	E		
Scripps-Booth (air)							B	A		
" " (water)	A	Arc	A	Arc	E	E				
" " (8 cyl)	A	A	A	A						
Selden	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Simplex	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
Standard (8 cyl)	A	A	A	A	A	A				
Stearns-Knight	A	A	E	A	E	A	E	A	A	A
" (8 cyl)	A	A	B	A						
Sterling (Wisconsin)	A	Arc	A	Arc						
Studebaker	A	Arc	A	Arc	Arc	Arc	A	Arc	A	Arc
Stutz	A	A	A	A	A	A	A	A	Arc	Arc
Velie (4 cyl)					A	Arc	A	Arc	A	Arc
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Vim	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Westcott	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
White	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Willys-Knight	A	A	B	A	B	A	A	A		
Willys Sin.	Arc	Arc								
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

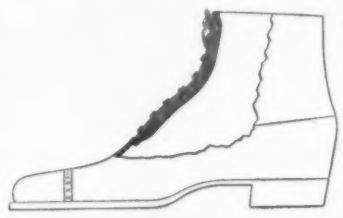
Electric Vehicles—For motor bearings and enclosed chains use Gargoyle Mobiloil "A" the year 'round. For open chains and differential, use Gargoyle Mobiloil "C" the the year 'round. Exception—For *winter lubrication* of pleasure cars use Gargoyle Mobiloil "Arctic" for worm drive and Gargoyle Mobiloil "A" for bevel gear drive.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

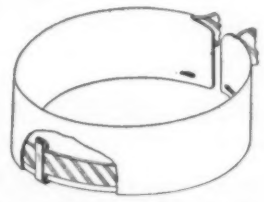
CUSHION INSTEP RAISER.—J. ROTHSTEIN, 1723 Pitkin Ave., Brooklyn, N. Y. The invention relates to boots and shoes, and provides a cushion instep raiser more especially designed for attachment to the tongue of a laced shoe or the fly of a



CUSHION INSTEP RAISER

buttoned shoe to overlie a low instep of the foot of a wearer, thus permitting the proper fitting of the usual shoes and to allow correct lacing or buttoning of the shoe and without danger of wrinkling the uppers or impinging the foot.

NECKTIE HOLDER AND COLLAR SUPPORT.—D. J. AHEARN, 76 Weirfield St., Brooklyn N. Y. The inventor provides means forming a supporting guide for a necktie and an attaching member for said necktie to a collar; provides a



NECKTIE HOLDER AND COLLAR SUPPORT

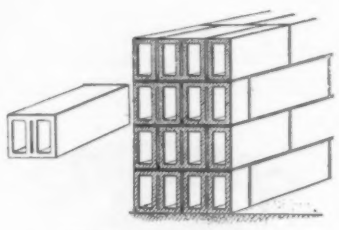
device having means for introducing a necktie thereinto and for subsequently inclosing said device to prevent the withdrawal of said necktie; and provides a collar-gripping portion for permanent attachment to the support thereto.

HAND PROTECTOR.—MARY JOHNSON, 410 W. 57th St., New York, N. Y. This improvement refers to laundry appliances and provides a protector or mitten arranged to enable the user to evenly and thoroughly rub hot starch into cuffs, collars and similar articles while in process of manufacture and without danger of injury to the hand of the operator.

GLOVE FORM.—J. A. ISAACS, 544 Mountain Ave., Westfield, N. J. This invention provides a glove form more especially designed for maintaining the proper shape of a glove and to prevent the same from shrinking while drying and after having been washed, and to support the glove for cleaning purposes and in such a manner that all parts can be readily reached both for cleaning and mending or repairing.

Of General Interest

HOLLOW WALL CONSTRUCTION.— F. HEATH, National Realty Bldg., Tacoma, Wash. In carrying out this invention the chief feature is the manner of laying blocks having a series of voids arranged longitudinally, the blocks being laid in such relation to one another in adjoining



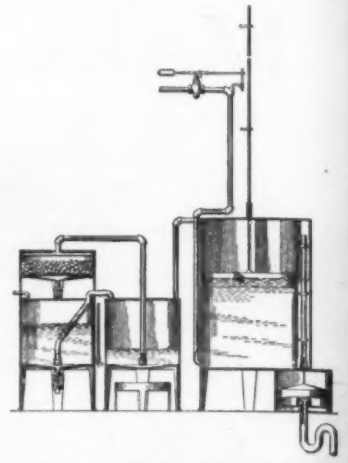
HOLLOW WALL CONSTRUCTION

courses that the webs of each block is in direct vertical alinement with the webs in the next one, and the central void of each block is in direct vertical alinement with the space between the blocks in the adjacent courses.

COLLAPSIBLE PONTOON.—G. JOHNSTON. Address N. BALL, 1005 N. Broad St., Richmond, Va. An object of this invention is to provide a collapsible pontoon which may be taken down or set up and which while being of exceedingly light weight, is nevertheless strong and durable. A further object of the invention is to provide a collapsible pontoon having few parts which may be readily assembled.

PIGMENT POWDER AND PROCESS OF MAKING THE SAME.—S. M. MCMURRAY, and J. R. PARRISH. Address the former, 50 Arcade, Smyrna, Tenn. The invention provides a pigment powder to be used in connection with an ink, such as printers' ink or stamp pad ink to bring out or intensify the impression made by the ink, and also to render said impression resistant to the action of gasoline.

APPARATUS FOR EXTRACTING VALUES FROM BODIES.—R. L. OGDEN, 504 W. Market St., Bethlehem, Pa. Among the principal objects which the invention has in view are: to continuously extract by leaching the soluble values of neutral bodies; to perform the above-mentioned operation at reduced cost; and to provide a



APPARATUS FOR EXTRACTING VALUES FROM BODIES

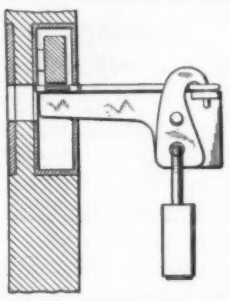
prime mover for performing the mechanical part of the process automatically and inexpensively.

Hardware and Tools

SASH CORD FASTENER.—M. M. BENSTER, Gettysburg, S. D. Mr. Benster's invention pertains to improvements in sash cord fasteners and guides used in window construction, and the object is to provide a sash cord attaching and detaching means whereby a window sash can be quickly put in place and removed into a room with equal facility for cleaning, repair, etc.

TELEMETER.—F. N. JOHNSON, 212 W. 8th St., Topeka, Ark. This invention provides an instrument for making linear or distance measurements which permits the use of various optical systems in such a manner that when two images, either partial or total, are reflected by mirrors or prisms into a telescope, sighting instrument, or directly into the eye and brought into coincidence to produce a clear image of the object viewed monocularly or otherwise, triangles will be erected with a properly calibrated part of the instrument and with the object viewed in such manner as to establish a ratio permitting accurate determination of the distance to be measured.

KEY LOCKING DEVICE.—M. B. PETERSEN, 222 Minor Ave., North, Seattle, Wash. The invention relates to means for application to a door lock and key to hold the key from being surreptitiously turned in the lock The device includes a member adapted to be inserted in the



KEY LOCKING DEVICE

keyhole beneath the stem or shank of the key and having a head provided with co-acting movable and relatively fixed members to engage the bow or ring of the key and hold the same against turning or displacement

OIL CAN.—W. ELLIOTT, Langlois, Ore. This invention provides a can having a receiving chamber for receiving a predetermined quantity of oil and having means in connection with the

OIL CAN

said chamber and operable at will, for ejecting the contents of the chamber through a spout or nozzle to the part to be oiled. The engraving shows the can in oiling position.

Heating and Lighting

HEATING FURNACE.—L. E. RUSSELL, Deposit, N. Y. The improvement provides a fire-box, combustion chamber and ash-box of novel design, whereby a large radiating surface is provided for enabling a higher abstraction of heat from the fuel, there being an arrangement of smoke flues in connection with the combustion chamber, whereby the air passing through the furnace is effectively heated.

EVAPORATOR.—W. J. GILLER, Warsaw, Ill. The object here is to provide an efficient evaporator which is particularly adapted for the rapid concentration of a solution; or the removal by evaporation, of excess water, or alcohol, or of

(*Concluded on page 294*)

Rapid Transit in the Factory

(*Concluded from page 283*)

The average factory or warehouse stores material or finished product from the floor up. A number of them, however, are learning to use the space from the ceiling down without paying any more rent. The portable piling machine recently developed to make this possible is of conveyor belt type. It consists of a steel channel frame to carry the moving belt, the whole being mounted on a portable truck with broad-tread casters. The incline of the frame is adjustable, somewhat upon the plan of the barber's chair. It may be raised or lowered to accommodate a pile of any height. It begins from the lower levels and piles the material to any altitude desired. The extreme height is determined by the conditions prevailing, and the machine designed accordingly.

To pull the machine from place to place in the warehouse requires no more labor than moving an ordinary truck. Trail wire to a motor is provided, with starting and stopping arrangements incorporated on the truck itself. Cleats on the belt serve to hold the load firmly upon the moving conveyor; and a section of rollers on an angle iron frame at the top provides a waiting table for the package while the man at the top is adjusting it to position. Another man to load the bundles on the belt completes the labor required. Progressive managers are realizing that space at the top is just as valuable as that on the floor, and are employing modern appliances to make it available.

A more ambitious type of portable conveyor is used for the unloading of vessels directly into barges or cars at a single operation and without hand labor. The Colon installation which we illustrate is designed primarily to handle barrels and sacks of cement, but it can easily be modified to meet a very wide range of demands. The conveyor machines are a part of the ship, and travel with it. When rigged in place for unloading, they afford a continuous movement from the darkest corners of the hold to the barges moored alongside. The electric control is exactly like the control lever and box of the motorman on a street car. It is located at a convenient vantage point on the bridge of the vessel, and from this point the machine may be started, stopped or reversed instantaneously. As each cradle on the endless chain deposits its load, consisting of a single barrel or a pile of sacks, it automatically returns to the hold, with the belt, for another load. A few men in the hold to bring the pieces to these conveyors, and in the barge to move them away from where they are deposited, constitute all the human labor necessary.

A similar installation is to be found at New Orleans, where it is used for the loading and unloading of bananas. That each conveyor installation presents a problem with its own special and unique features is to be seen by comparison between these two. At Colon, in order that the same ship might unload indifferently at many points, it was necessary to place the conveyor unloaders aboard the vessels. In use the extended end rests upon the dock; hence it was necessary to provide means for securing the balance to compensate for the natural pitching of the ship when tied to the dock. At New Orleans, where many ships were to unload at the same spot, the machine was located on the docks, with only the light movable end on the ship; and this problem was not nearly so serious. Here, however, the outstanding difficulty was the development of a device that would carry the bananas without breaking the bunches. This was accomplished by fastening the leather belt to its steel carrying frame at intervals only, leaving a slack between these fixed points to sag down into a pocket of just the right size to carry a bunch of bananas neatly and safely.

It may be remarked in conclusion that of the many war-orders furnished Russia by this country, none was more appreciated than a consignment of portable conveyor belts of capacity from one to three tons per hour, which have seen constant hard service in unloading at Archangel.

How the Government Helps Foreign Trade

(*Concluded from page 284*)

that American manufacturers may want to import from across the Pacific. An investigation of this kind is something out of the ordinary run of Bureau work, as it is concerned more with investment opportunities than with markets. But it is everywhere agreed these days that there is American money available for investment in foreign countries, and that in becoming a creditor nation some of the trade advantages that have hitherto been enjoyed by European countries only will be obtained by this country. With this fact in mind, another agent has been designated to go to South America and devote his whole time to a study of the opportunities there for the investment of American capital.

The markets for electrical goods in South America and in the Far East have seemed important enough, actually and potentially, to warrant a careful study. An agent has been sent to each district. Electrical equipment, certainly, is one of the lines in which the American manufacturer is supreme and there is no reason to suppose that he will fail to hold his own abroad when once he makes up his mind that foreign trade is really necessary.

Closely connected with the study of ports and transportation facilities in the Far East is the newly undertaken investigation of Far Eastern markets for American railway equipment and supplies. In fact, the investigations of ports and transportation facilities, railway supplies and equipment, mineral resources, and electrical goods in the Far East are all closely connected, and will supply a series of reports of substantial value to American engineers, contractors, capitalists, manufacturers, and exporters.

I have dwelt at some length upon the newer work undertaken by the special agents, because it is not so well known generally as is the work of the other branches of our information-gathering service. A great deal has been printed about the work of the American consul and the American commercial attaché, and in a general way the commercial activities of these officials are fairly well known to the business community. The consuls are employed by the State Department, but their commercial reports are by special arrangement turned over to the Bureau of Foreign and Domestic Commerce. There are about three hundred consulates, and as every one knows, they are located in all the principal commercial cities of the world. There was a time when the American consul did not inspire much confidence as an observer of commercial conditions and business practices, but that is not true to-day. Consuls to-day are appointed only after a most careful examination, and some knowledge of business practice is demanded in all candidates. Men are no longer appointed to the service as a reward for political activity.

The commercial attaché is employed by the Bureau of Foreign and Domestic Commerce and is accredited to the American embassy or legation in the country to which he is assigned. There are now attachés at London, Paris, Petrograd, Peking, Melbourne, Buenos Aires, Rio de Janeiro, Lima, and Santiago, Chile. Until recently there was also an attaché at Berlin. The attaché is a resident official, but unlike the consul he is expected to devote all his time to commercial matters, and is at liberty to drop details at any time and follow up a big business development unhampered. In this way the attachés have removed the transportation tax on coal in Spain, making it possible for American coal to enter this market; have assisted in diverting Bolivian tin ore from Europe to America; have induced the Chinese Government to buy American textile machinery for the new Government mills; and have had an important part in many other developments having a direct bearing on American trade. A world-wide investigation of the markets for American hardware has recently been completed by the attachés.

Once information has been furnished by the special agents, by the consuls, and by the commercial attachés, the next step is to give it the widest circulation among interested concerns and individuals. This is not an easy task. It is almost as difficult as getting the information together in the first place.

Our best-known medium for communicating foreign-trade information to the business public is the daily *Commerce Reports*. This is a 16-page commercial newspaper devoted entirely to foreign trade. It is made up of the shorter reports from agents, consuls, and attachés. Occasionally the more important "live" news is cabled and then it appears in print within 24 hours of its receipt in Washington. At least one page of this paper is devoted to "trade opportunities," that is, opportunities for securing specific orders from foreign buyers or for making connections with foreign houses that will eventually lead to orders. This page has brought millions of dollars' worth of business to American firms. A concern in Chicago which recently entered the foreign field is now doing over $100,000 worth of such business a year, and 75 per cent of that total originates in the trade-opportunity page of the *Commerce Reports*.

The longer reports received from our representatives are published separately as monographs. Those already published cover almost every line that can possibly be connected with foreign trade. Formerly it was the custom to give these monographs away for the asking, but lately we have fixed nominal prices to cover the cost of printing, and by applying every-day business selling methods we now succeed in selling more publications that formerly we were able to give away.

The district and coöperate offices which the Bureau maintains in the principal business centers in this country are also a part of our distribution scheme. They are in close touch with the individual manufacturer and exporter and are wide-awake sources of information. They are the headquarters for the agents, consuls, and attachés when they return to this country. It is here that they meet and talk over personally with the business man the many problems that can not be thoroughly threshed out in print.

It is in the district offices that the manufacturer gets his chance to examine the samples collected from the world's markets by our representatives. When a collection arrives a notice is published in *Commerce Reports* that it will be sent from district office to district office, and the agents in charge of such offices then inform the individual firms that it will be on exhibit on a certain date. When a collection has gone the rounds it is returned to the district office in the Custom house in New York, where it is added to the permanent collection, which is growing to rather astonishing proportions. When the attachés were instructed to make the hardware investigation, already mentioned, they were furnished a liberal sum to purchase samples of the articles of hardware most favored in their respective districts. These samples form perhaps the most impressive feature of the whole exhibit, being followed in this respect by the cotton-goods samples. They show the manufacturer at a glance the quality, design, and price of articles with which he must expect to compete if he decides to enter foreign fields.

There never was a time when the country needed authentic foreign-trade information more than it does to-day. Manufacturers who once looked upon foreign trade as a side line, and not a very important side line at that, are now setting about in a very serious manner to build up overseas trade. In some instances I know there is considerable anxiety in their manner. Some of our industries must continue to sell abroad when the war is over or suffer severely. We can not solve all the problems for individuals in such industries. We can not sell goods for them. We can not do their thinking for them. But any intelligent manufacturer or exporter can get important help from us. And it is his duty to make the most of this service which his Government has placed at his disposal at the public expense.

Connecticut's Military Census

(*Concluded from page 280*)

in the event of war, that he would be called upon for neither more nor less than others of substantially the same classification. These efforts were completely successful; the population of the state accepted the census with enthusiasm. A very considerable number of the citizens resolved themselves into an amateur detective force, to ferret out and report to the enumerators those who had escaped the count. In the New Haven factories a good many men were inclined to refuse answers to the questions; but they very soon found themselves forced to answer—and not by threats of discharge, but by much more vigorous threats from their fellow workmen. Of course the Act affords legal means for compelling answers, but it is preferred not to use these.

The census will not stop with enumeration of the males of the state, though that was its primary object. Already over two thousand trained or untrained female nurses have enrolled by means of a special blank issued for this purpose; and of these no less than 85 per cent have signified willingness to respond to a call for emergency service anywhere. A similar question was deliberately omitted from the blanks for the general male enrollment, in the fear that it would convey an unfortunate impression. A blank has been sent to every corporation and firm in the state asking what and how much they make which could be of use in various emergencies, what part of their employees should be exempted from military duty on the ground of industrial necessity, and what machines they have.

The experience of taking this census has led to surprisingly few suggestions as to better ways which might have been employed. The office detail described has stood the test without a strain. It appears that the blank should have stated explicitly that the home address was wanted, not the business one; and the men of the state might well have been asked to state what languages they speak and read. Aside from these items, no amendment or addition to the questionnaire has appeared desirable.

The information of this census is of the greatest value. Every state can and should emulate Connecticut's action. But let no state call upon the federal government for use of the franking privilege in this connection; let no state suggest that the local post office list—lists which would, in most cases, put any directory to shame—be placed at its disposal in the making up of preliminary check lists. Franking privileges and post office lists are things sacred and apart. By specific rulings of the government in connection with the Connecticut undertaking, Uncle Sam will let you make a census, and he may be willing to use it after you have made it; but you mustn't think that he is going to help you make it, because he isn't.

We are indebted to Mr. Joseph W. Alsop a member of the Bureau of the Military Census for much of the information contained in this article.

The Current Supplement

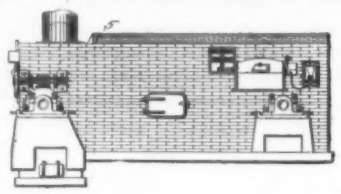
FEW things attract more universal attention throughout the world than an eclipse, and there is the prospect of no less than seven of these spectacular events in 1917 and three in 1918. An unusually able explanation of *How Eclipses Occur* appears in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2150, for March 17th, 1917, and will be continued in the following issue. This article is by an eminent authority and explains by graphic methods how solar and lunar eclipses occur, being copiously illustrated by new and original plates. A list of dates of important eclipses in the past, as well as of those expected in the near future is included. The article on *What is Disease?* is concluded in this issue. An article on *Gravity* gives an account of observations made in Canada. Other articles of importance include *Stone and Concrete Foundations, The Metric System, Man and the Universe, Development and Toning of Motion Picture Films, New Evidence in Regard to the Instability of Human Types* and *The Care of Ancient Monuments.*

RECENTLY PATENTED INVENTIONS

(Concluded from page 288)

both alcohol and water as in the case of beer or wine.

OVEN.—E. C. GREINER, care of Chas. Gunderoth, Box 773, Miami, Ariz. In this invention an endless carrier supports the material to be baked upon its upper run, and having horizontal plates connected therewith for supporting the material, and having means for moving the endless carrier together with an improved form of heating



OVEN

mechanism, consisting of a series of substantially U-shaped tubes arranged alongside each other with their arms in register, each connected with the heating chamber at one end below the endless carrier and with the smoke chamber at the other above the endless carrier, said endless carrier being between the upper and lower arms of the tubes.

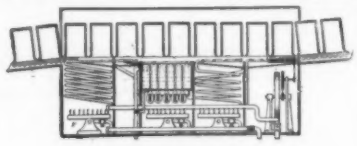
ELECTRIC LAMP.—A. D. COX, Box 14, Winterville, N. C. The invention provides a lamp having two separate resistance or light giving circuits, one of those circuits being arranged to be brought into operation prior to the other, so that in the case of the burning out of the filament of the first circuit the second circuit may be brought into use, thereby increasing the life of the lamp.

Household Utilities

WINDOW VENTILATOR.—C. A. ERICKSON, Cashton, Wis. This improvement has reference to window ventilators of that type disposed between the window sill and bottom of the lower sash, so that when the latter is raised a few inches air can enter a room between the meeting portions of the upper and the lower sashes.

TRANSVERSE CORD FASTENER.—J. A. DONNELLY, care of Mrs. Sheerger, 174 W. 81st St., New York, N. Y. Among the objects of this invention is the provision of a novel form of traverse ring or cord attachment for traverse rings enabling the traverse cord to be attached directly to the traverse rings by any member of the household whether skilled or unskilled in this particular art.

DISH WASHER.—A. D. BUSH, 516 Washington St., Los Angeles, Cal. Mr. Bush's invention has reference to an automatic dish-washing machine. The object thereof is the provision of a simple, sanitary and inexpensive



DISH WASHER

machine which will rinse dishes to be washed, wash them with a boiling, cleansing solution, rinse them to remove the cleansing solution, and deliver the so-cleaned dishes. The accompanying engraving shows a longitudinal section of the dish-washing machine.

Machines and Mechanical Devices

PRINTING MACHINERY.—A. B. EVANS, Highbank House, Harehills Lane, Leeds, England. This invention relates to web printing machinery of the type in which the paper passes from a reel to cutting or perforating apparatus or the like in order that it may be divided into sheets, which are then carried forward to the printing devices, and is especially applicable to the machines known as all-size web printing machines.

MOTOR POWER TRANSMISSION.—A. MASS, 225 South 11th St., Newark, N. J Among the principal objects which the present invention has in view are: to provide means for transmitting power from a wabble disk motor; to avoid the employ of packed bearings in said transmission; and to simplify the construction and lessen the cost of manufacture of a motor having the transmission referred to.

Railways and Their Accessories

RAILWAY SIGNAL SYSTEM AND APPARATUS.—M. H. LOUGHRIDGE, Bogota, N. J. The invention relates generally to a system whereby a visual signal is operated in the locomotive cab with reference to the charcateristics of the track, and to which a means may be added of connecting the motive power and the braking power of the locomotive. It particularly relates to a selective means of operating the said cab signal and controlling means in response to various characteristics of the track.

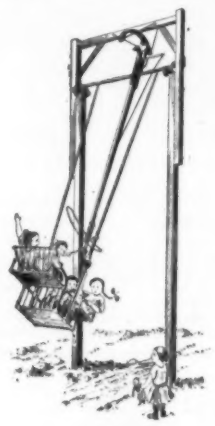
RAILWAY GATE OPERATOR.—D. E. HUSK, and T. C. COOPER, 64 Norwood St., Newark, N. J. The invention relates to the operation of railway gates at crossings, and provides operating means which are entirely automatic in action whereby the human element is removed, although the invention provides supplemental operating control means manually operable, as in a signal tower, or switch tower.

Pertaining to Recreation

GAME APPARATUS.—D. HORVITZ, 507 Berwich Ave., Detroit, Mich. In the present patent the invention, has for its object the provision of a game apparatus with which may be played a new and interesting game of a military character, the apparatus being so arranged that many offensive and defensive plays may take place under various conditions.

COMBINATION SHELTER OUTFIT.—G. W. GAIL, JR., Tudor Hall, University Parkway, Baltimore, Md. This shelter outfit is for outdoor use in camping, sleeping outdoors, etc. The invention provides an outfit of a sheet material having features and appurtenances whereby to convert the article into a sleeping bag, a tent or lean-to, or into a poncho, and so formed as to be folded into small compass when not in use.

PLEASURE SWING.—J. E. CAREY, 112 East Cheyenne St., El Reno, Okla. The present invention has reference particularly to pleasure swings, and aims to provide certain improvements in this class of pleasure apparatus which will



PLEASURE SWING

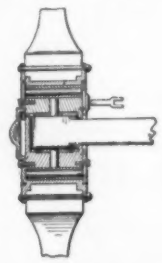
increase the effectiveness and pleasure thereof, which will eliminate friction to a considerable extent, and which will be safe at all times. The engraving shows the practical use of the swing.

Pertaining to Vehicles

SIGNALING DEVICE.—G. J. KLOEPFER and C. F. KLOEPFER, 10 W. High St., Springfield, Ohio. In this device a tubular casing is provided adapted to be arranged transversely of the wind shield and the supporting brackets thereof, having at each end a casing, and a signal in connection with each casing, mounted to swing into horizontal and vertical positions, and wherein a mechanism for the signal is mounted in the casing and in the tube, and wherein means is provided in connection with the mechanism for locking the signal in either position, and wherein a mirror is mounted on the rear face of each casing.

WIND SHIELD.—K. FEILCKE, care of The Pathfinder Co., Indianapolis, Ind. The invention pertains to wind shields for automobiles, and provides such a device so constructed that for all possible conditions, weather and road, the greatest possible comfort will result to the occupants. It provides means convenient to the driver whereby he may adjust the wind shield into any desired position with one hand.

MOTOR VEHICLE WHEEL HUB.—J. T. SHOAF, 2723 A. St., Eureka, Cal. One of the principal objects of the invention is to provide a wheel hub of such nature that the wheel is suspended or supported upon the axle at a point



MOTOR VEHICLE WHEEL HUB

occurring in the center of the wheel so that strain upon the wheel will be equalized and will not be unequally distributed as in the case in wheels of the type carried by steering knuckles, brackets, and the like.

Designs

DESIGN FOR A LOCK CASING.—S. SEGAL, care of Burglar Proof Lock and Hardware Corp., 75 Fulton St., New York, N. Y. This ornamental design for a lock casing is somewhat oblong in form, round at one end and at the other straight with two cut out spaces to the depth of about one quarter of the length of the casing.

DESIGN FOR AN AUTOMOBILE TIRE.—P. DE MATTIA and B. DE MATTIA, care of De Mattia Bros., Garfield, N. J. In this ornamental design for an authomobile tire the face view of a fragment of the tire shows the tread portion thereof.

DESIGN FOR A TOY.—P. M. DAVIS, 251 Schaeffer St., Brooklyn, N. Y. In this design the head is large and of cylinder form and flat on top. The face features are crude but very impressive. The body is smaller and square the arms and legs straight and flat. A feather is placed upright from the center of the crown of the head.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

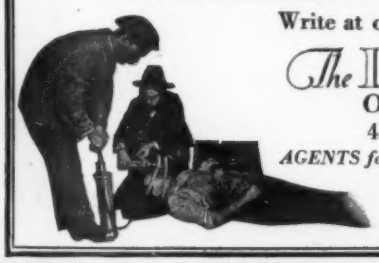
A Mine Rescue Squad Equipped with Draeger Apparatus

OXYGEN, one of nature's most wonderful elements, has been harnessed and put to work for the safety and comfort of man. Pioneering into untrodden fields Draeger engineers have developed oxygen apparatus, now being made under basic U. S. patents, that has opened up unending avenues for scientific research, for industrial development, and for the conservation of life.

There is no field of business that does not need the protection of Draeger Apparatus. For the safety of your investment in your business, for the safety of your employees, and for your protection against losses under compensation laws it will pay you to at least investigate.

Draeger Breathing Helmets have been devised, giving the diver unrestricted freedom of movement. Smoke Helmets have been developed, protecting the fireman in the densest smoke, chemical gases and ammonia fumes. Mine Rescue Apparatus has been perfected that has closed the door on tragic mine catastrophies. Medical Apparatus has been invented, making operations safer, and recovery more sure. The Draeger Pulmotor, alone, has saved lives beyond count. In cases of respiratory failure resulting from drowning, electric shock, gas poisoning, asphyxiation, etc., where death has not occurred, the Pulmotor will restore the victim to full vigor.

Write at once for interesting literature



The DRAEGER
OXYGEN APPARATUS CO.
418 First Avenue, Pittsburgh, Pa.

AGENTS for Wolf Safety Lamp Co. of America
MEMBERS of the National Safety Council

The New Type "B" Pulmotor—the latest development in resuscitation apparatus.

Standardized Counting Brings Economy

That Is Why Thousands of Manufacturers Have Installed

NATIONAL COUNTING MACHINES

THESE machines have established a standard, fixed way of counting in the place of the wasteful, error-ridden, never-twice-alike hand method.

Anything so mechanical as counting masses of like pieces of material should be done by a machine; not by a workman's mind. Mind-counting is a relic-task of the "hand-made" age. Moreover it is the costliest way to count. The cheapest way is the modern way—the National Counting Machine way.

The National Counting Machine has brought permanent counting economy to over one hundred separate industries by standardizing their counting operations.

It counts tiny metal parts, heavy castings, or like unit material of any substance or kind in bulk lots—counts with unequalled precision and almost instantly.

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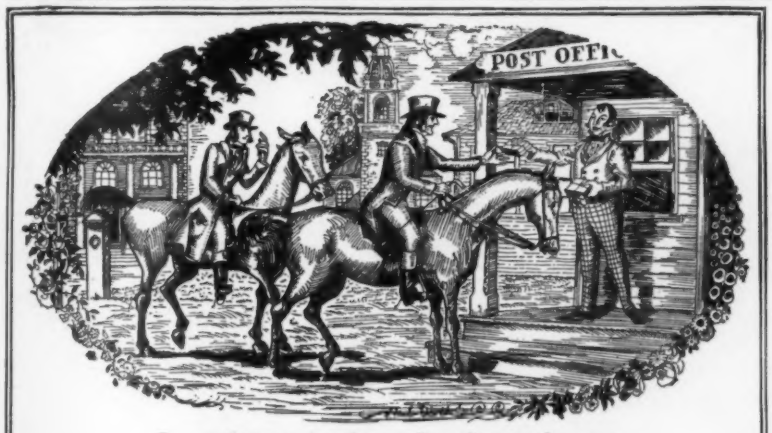

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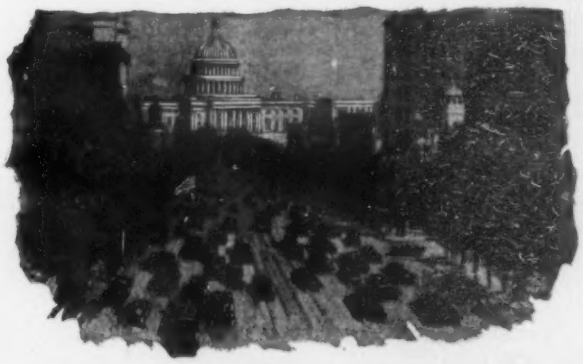

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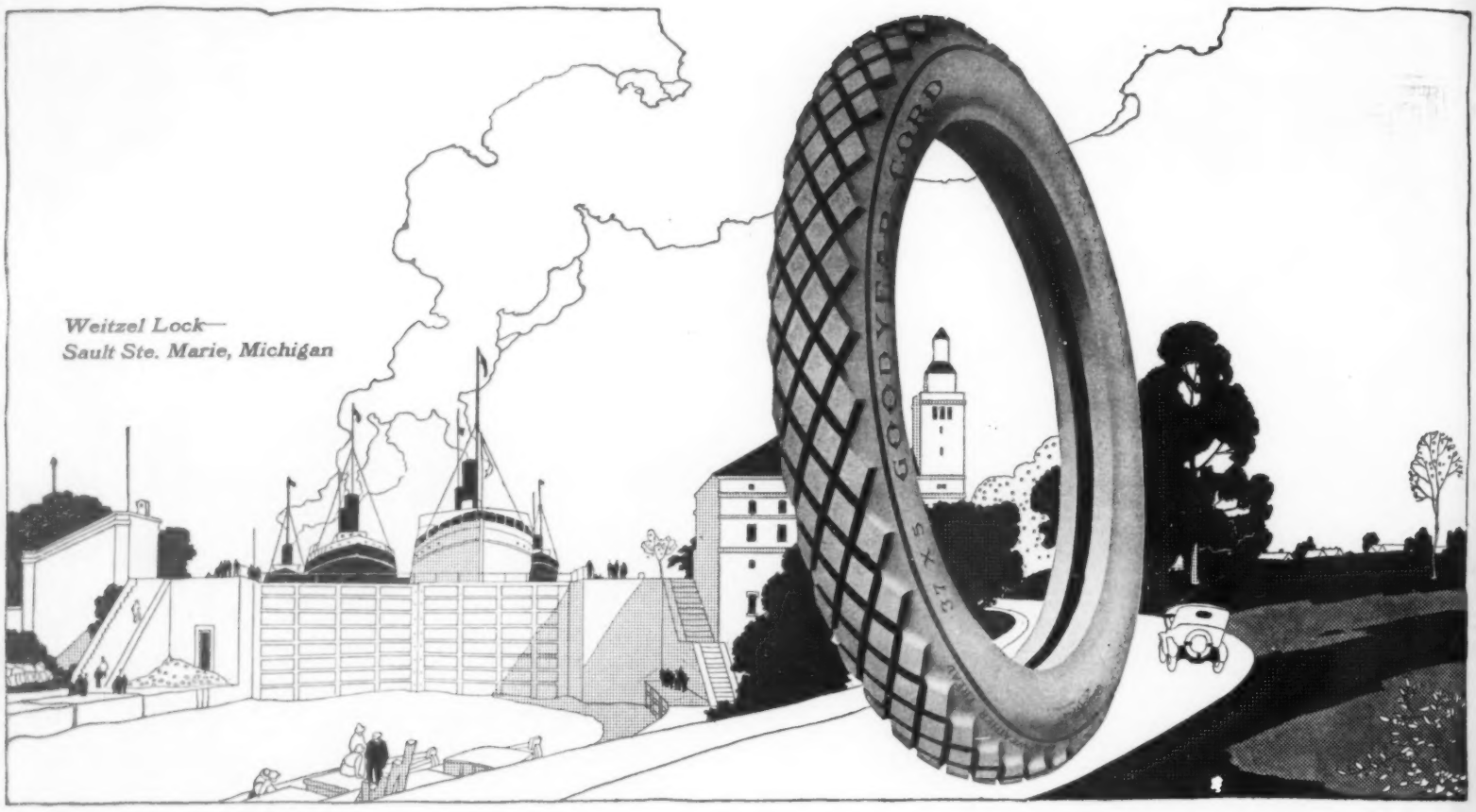

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